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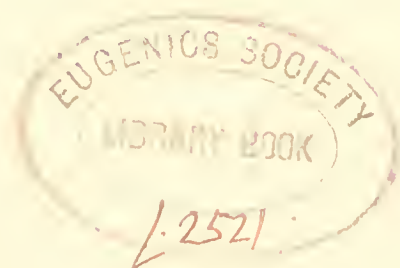
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# HUMAN ECOLOGY



# HUMAN ECOLOGY

BY

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## ACKNOWLEDGEMENTS

TO several of my colleagues and other friends I have to express my indebtedness for reading through the manuscript of this work, and offering much good advice. I am especially indebted to General Smuts for many stimulating discussions, and for writing an introduction.

With one point, which he makes, I very thoroughly agree. The subject of Human Ecology, I am convinced, is far more promising than I have been able to show.

Yet its general plan and its outlook are so wide that the writing of this book has involved very extensive reading. The works mentioned in the various 'Bibliographies', appended to the separate chapters, are those which have been most freely drawn upon. The aim, throughout, has been (without burdening the text with footnotes) to give sufficient indication of sources of information to enable any reader, who is interested in any particular point, to follow it up without much trouble.

J. W. B.

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## INTRODUCTION

By GENERAL THE RT. HON. J. C. SMUTS, P.C., C.H., F.R.S.

I READILY respond to Professor Bews's invitation to me to write a short introduction to his work on Human Ecology. I owe him a debt of gratitude for much that I have learnt from him in Plant Ecology. The plant life of the African Continent has been a constant hobby with me, and indeed my main relaxation from the strains and trials of human affairs. In this fascinating domain I have profited much from the work of Professor Bews. He is a very distinguished botanist, and has made outstanding contributions to African botany. Especially has his ecological approach to our botany proved helpful and thrown light on many dark corners. His great accomplishment as an ecologist has in particular enabled us to understand how the tropical flora of Africa has in the course of time marched south towards subtropical and temperate areas, and has continuously adjusted itself to the new conditions of climate, latitude, soil, and rainfall, until it covers most of southern Africa with a most diversified flora, very different from its tropical ancestry. The ultimate unity of our African flora is thus maintained, while its wide differences in form are explained on ecological grounds.

With his ecological equipment and outlook, Professor Bews has in this book approached the study of human cultures and civilization in general. It is an intriguing effort, and we must all welcome this scientific approach to the problems of our human advance. More and more it is being felt that what is wanted is more science in the consideration of human problems; the lack of science in our affairs is considered one of the main reasons why our human world is becoming more and more chaotic, while science in her domain is making a triumphal progress. Here an accomplished biologist, with a fine record of achievement in his own special field, endeavours to apply his methods and outlook to the consideration of human problems, human cultures, and human advance. Whatever the result, we can only give him our blessing and for all our sakes wish him luck. In so

novel and difficult an undertaking even a limited success would be worth while, and we are grateful to Professor Bews for pointing the way in what may yet prove a fruitful line to follow up to its ultimate consequences. My own impression after reading the manuscript is that the attempt was well worth making, that a new and fruitful setting is provided for the vast amount of anthropological work that has accumulated in the last half century, and that the ecological approach is fully justified. At the same time I have the feeling that this special line of approach is even more promising than would appear at first sight, and that the ecological method in human studies which is here begun may yet prove a most powerful instrument in anthropological and sociological research.

Professor Bews has rightly stressed the necessity for the holistic view-point, of which the ecological method is a special scientific application. The world is not a chaos, a chance selection of items and fragments. It is a closely interwoven system of patterns. What we in our human way call plan and design is present everywhere. This is not to be understood as naïve anthropomorphism. Our most painstaking effort at understanding the world discloses certain dominant features in it—rhythm, regularity, inter-connexion, and linkings up, an interplay of active relationships which is creative of structures, forms, patterns. Such is reality—a vast Pattern of patterns. And to trace these patterns or wholes is to discover the lineaments of beauty in all its forms, whether we call them beauty or truth or good. They are all, but holistic harmonies in the nature of things. Nothing exists for itself alone; there are no isolated units, but only structured patterns and inter-relations, from the primordial electrons to the most developed physical or moral or social complexes in the universe.

This is the holistic doctrine which underlies ecology. The organism is not itself alone and in isolation. As a unit it is a mere static abstraction. The real dynamic unit is the organism functioning in its environment. This complex concept is the real biological unit and starting point. Life is living, and living is an active reciprocal relation between organism and environment. This is the central concept in ecology,

and it has already led to a revolution of our biological sciences. It enables us not only to account for individual development, but also for the existence and development of communities, societies, their histories, phases, and climaxes and all the complexes which we find in the living nature. In the end they all follow certain large rhythms which prevail in nature. Plant communities, such as forests, grasslands, scrub bush, associations, and the like, are but ecological products of climate and other large or minor rhythms in nature. They form a moving equilibrium of patterns, expressive of something deeper in nature. The small patterns are thus grouped into the larger patterns, all expressive of the inner rhythmic nature of reality. The vision of this Harmony is what the gods feed on, and what mortals strive for, according to the Platonic myth.

In biology it is possible to trace the laws of ecology, because the environmental factors are regular, or at least definite and certain, and not arbitrary. Weather may change but it is an objective fact, which we can build on, and which can be statistically dealt with.

Not so in human affairs; and here comes the difficulty of applying ecological laws in the human sciences. In biology the environment is given, is objective fact, and its effects can be ascertained and formulated in laws. Man, however, shows his superiority to nature by largely creating his own environment. His intelligence enables him to circumvent nature, to command the forces of nature, and thus to alter the natural situation into what suits him. Thus the subjective human factor enters into his environment. The progress of scientific knowledge and technology is continuously revolutionizing our human environment. Under such circumstances, one could only apply the ecological laws, derived from biology, with caution and circumspection to human affairs. And this is not the only snag. The human organism is the most plastic and adaptable and undifferentiated of all. It is curious how this most complex of all organisms is, in many respects, the most primitive and unspecialized. Man therefore easily adapts himself to the most diverse and extreme conditions. While floras and faunas disappeared in the Great Ice Age, he found it only a greater spur to his progress. His innate

adaptability and his intelligence have made him largely independent of environmental conditions and even of natural laws. No wonder that ecology will have a far more formidable task to perform in the human sciences than in scientific biology. Even here, ecology will supply scientific clues which in the end may lead us on to the right track. The adventure of science will lead us more and more towards the human; and ecology, and especially holism, may prove far more fruitful in that great quest than orthodox scientists may be prepared to admit to-day. At any rate, necessity is laid on us, and we dare not sit still in a world to-day fuller of dangers for our race than ever before. We must move on, and science appears to be the royal road of advance. We cannot accept at their face value the philosophical speculations of a Spengler—that civilization is an organism which grows and decays of its own inner unalterable laws, and that nothing can arrest the disappearance of our own civilization. Nor can we accept—in the face of all that genetics has taught us—that environment is all, and the organism merely a creature of it. Somewhere between lies the truth we are after, between the one-sided environmental and organismic views. Human Ecology, in doing justice to both the great factors that shape our fate, may yet prove the scientific reconciliation between these extreme views. My reflections on science, on the nature of knowledge, and on human affairs have only deepened my own impression that Holism in its various applications is the pathway to explore to the future of science and philosophy, and to human welfare.



# I

## INTRODUCTORY

Definition of Ecology—Plant Ecology—Animal Ecology—Human Ecology—The Plan of the Present Work—Bibliography.

TO define ecology, in a brief concise way, is no easy matter; in fact, it will require at least an introductory chapter to give some idea of what it means. The word itself is derived from the Greek *οἶκος*, a house or home, the same root word as occurs in economy and economics. Economics is a subject with which ecology has much in common, but ecology is much wider. It deals with all the inter-relationships of living organisms and their environment. It has been said that ecology represents not so much a branch of biological science as a certain attitude of mind with regard to life, and there is a great deal of truth in the statement, which will be made clearer to us as we proceed.

The first all-important fact, on which the greatest possible emphasis must be laid, is that life apart from environment does not exist, and cannot be conceived. Life consists essentially of a process of interchange between the life-substance or protoplasm and the environment. At the same time the term environment apart from life is, of course, meaningless.

The interchange between the living protoplasm and the environment represents the working of the living machine. When this working ceases the organism dies. It no longer functions. Whether it can ever temporarily altogether cease functioning and afterwards recommence, without dying, is perhaps a point that might be debated, though hardly at the present stage of our discussion. It may be remarked, however, that, even in the case of the resting seeds or spores of plants, the evidence available goes to show that the life changes are still continuing during the resting period, though at a very slow rate. Changes in the *rate* of functioning are obviously continually taking place, yet while life goes on, the functional relationship between environment and organism remains. Environment, function, and organism constitute together what has been called the fundamental

biological triad. The triad must be studied as one complete whole, and this study is essentially what we mean by ecology.

The importance of a holistic approach to the study of ecology can scarcely be over-emphasized. Various biological workers from time to time have tended to lay emphasis now on the environment, now on function, and now on the organism itself. All such studies are important, since they contribute to the proper understanding of the triad as a whole, but it is the task of the ecologist to preserve a true balance. In the earlier stages of its development, and even still to some extent, ecology has perhaps tended to lay too much stress on the first term of the triad. The environment certainly does profoundly affect the organism's structure and behaviour, but it must always be remembered that the functional relationship between environment and organism is a reciprocal one. The organism also continuously influences the environment.

Modern ecology realizes that there are many lines of approach to the study of living phenomena. It always keeps the necessity for viewing life as a whole well to the forefront, but it regards the fundamental triad now from one end and now from the other. It studies it from every possible angle, it approaches near to it by making use of every separate branch of biological science, by utilizing all the means at its disposal in the form of modern scientific technique, but it also, at intervals, so to speak, stands back from it and obtains a general view; this general view ecology regards as the nearest approach to the truth concerning life that science is likely to obtain.

Ecology, then, combines analysis with synthesis. All science, in a general way, endeavours to do the same, but many branches are satisfied to pursue analytical methods for long periods on end, thus obtaining a more and more minute and detailed knowledge of the intricacies of Nature. Ecology, while it by no means neglects such analytical methods and discoveries, regards them as means to an end rather than the end itself.

Since living organisms are either plants or animals, ecology can be divided into plant ecology and animal ecology. From the latter it is now proposed to separate human ecology,

man being different in so many respects from all other animals. A brief consideration of the aims and methods of plant and animal ecology will help to make clearer the purpose of human ecology.

## PLANT ECOLOGY

Plant Ecology was first in the field and shows relatively the greatest advance. It grew out of the earlier studies of plant geography, and the descriptive study of vegetation in general. The name itself (originally spelt *oecology*) only came into general use after it was employed by Reiter (1885) and Haeckel (1886). Rapid progress followed the publication of text-books by Warming, Schimper, and others. In 1905 Clements published his *Research Methods in Ecology* which did much to focus the attention of botanists on its possibilities. He regarded ecology as the 'dominant theme in the study of plants', as 'the central and vital part of botany'. He regarded physiology and ecology as essentially identical, though he admitted that up to that time ecology had been merely superficial while physiology was too specialized. The greatest need, he felt, was the introduction of method and system into ecology and a broadening of scope and new objectives into physiology. He devoted much attention to the introduction of experimental methods into the field study of vegetation. The various environmental factors such as soil conditions, water content of the soils and of habitats generally, light, temperature, rainfall, &c., all must be measured accurately and correlated with responses in the vegetation, which in turn must be measured as accurately as possible. Biotic factors must also be studied experimentally in the same way. The organic or living environment is just as important as the non-living. Plants influence one another, and the life of a plant in a complex, highly organized plant community such as a forest, is vastly different from the life of one growing in the open. The microflora and fauna of the soil, parasites, insects, earthworms, field mice, rabbits, grazing herbivores (to mention only a few examples of biotic factors) and, most of all, man himself, all exercise a profound effect on plant life.

As the new ecological view-point gradually became more

and more generally adopted, different lines of investigation were followed up. Much of the earlier research work consisted in the analysing and classifying of the different types of plant community and the mapping of them geographically. Such analytical descriptive work is simple and straightforward, but is not without value, if only for the facts that are thus definitely recorded.

*Synecology* is the term applied to such investigations of the social life of plants. It is a term almost synonymous with sociology, and some writers would like to restrict the term ecology to such studies, though without any very adequate reason. Plant communities consist of groupings of plants of greater or less size and importance. The term 'plant formation' is applied to the larger plant community as a whole, which is dominant over any distinct climatic area. It is composed of smaller communal units, known as plant associations (or consociations if a single species is dominant). Within a plant formation or association subordinate types of community may also be found known as societies, e.g. a society of bluebells on the floor of an oak forest. Thus a forest is a plant formation in regions where the rainfall and climate generally permits of forest growth. The tropical rain forest, the north temperate deciduous forest, the cold temperate pine forest are all different types of plant formation. In the tropical forest there is a very complex series of plant associations or consociations and innumerable subordinate societies in the tangled undergrowth. Climbing plants and epiphytes are extraordinarily abundant, and the whole formation is exceedingly difficult to analyse. Examples of the deciduous forests of such a country as North America are much simpler consisting of such associations as oak and hickory, birch and maple, while in England many forests are composed of simple consociations such as oak, ash, beech, or birch. Forest develops in certain climatic areas while under different climatic conditions grassland is the dominant type of vegetation. Here the plant formations are, as a rule, simple. The plant associations, consociations, and societies may be very uniform over immense tracts of natural grassland or, on the other hand, they may be exceedingly varied over comparatively small areas. Under more adverse climatic con-



ditions which do not permit of either grassland or forest development, desert or semi-desert plant formations are found. They are of an open type, the ground not being completely covered by vegetation. The separate plant communities found under such conditions, and elsewhere in open spaces where the vegetation is not stabilized, are sometimes spoken of as colonies.

Space limitations prevent us from entering into further details, but enough has been said to show that, as the task of describing the vegetation-covering of the world has proceeded, a more or less precise nomenclature has also been evolved. This has taken time, and has led to a good deal of writing and debate. Even now there are different systems of nomenclature in use, though the one outlined (following Clements) is at least fairly generally understood, if not followed by all. In the same way in the study of human communities a definite nomenclature is required. As we shall see later, such ethno-sociological terms as family, tribe, sept, clan, &c., have to be carefully defined.

*Plant succession* is the study of the development of plant communities. No plant community remains completely static. It undergoes changes which in many ways are comparable to the growth and development of individual plants. As Clements puts it, the plant formation is an organic unit, exhibiting activities or changes which result in development, structure, and reproduction. The triad of environment, function, and organism therefore, applies to the plant community as a whole as well as to the individual plants of which it is composed. Synecology has a dynamic as well as a static aspect. The general tendency in succession is towards stabilization, resulting in the production of what is known as a climax condition, when the climatic forces and vegetation responses are more or less in a state of equilibrium.

The earliest stages of a succession consist commonly of annual plants and other freely seeding types. They are light-demanding, drought-resisting, efficient, colonizing pioneer types. They prepare the way for the succeeding stages, but do not themselves survive, being gradually killed out by the plants which succeed them. The pioneer stages of the succession are relatively simple, unstratified, and often perfectly

uniform. The later stages are much more complexly organized, consisting of dominant plant associations and numerous subordinate plant societies. Pioneer types of plants tend to be rather widespread—often much more so than the types which follow them in the succession; pioneers are also more plastic physiologically and show a great range of variation both in structure and responses. They are usually, from the evolutionary point of view, rather highly evolved types. A great many of them, for instance, belong to the family Compositae. The pioneers have to react mainly to the inorganic factors of the environment. Climax types, on the other hand, are much influenced by biotic factors as well. In the climax stages of forest development large numbers of subordinate types of plant growth form (climbing plants, epiphytes, shrubs, undershrubs, and herbs), may often be as highly evolved as the pioneers, but they have evolved in response not so much to climatic factors as to the social complexity of their forest environment. They have responded to the influence of the surrounding plants. The dominant trees of the forest, on the other hand, are commonly ancient stable phylogenetic types.

Though it is dangerous to press analogies very far, it is interesting to note, in passing, that in human communities, pioneer men, like pioneer plants, are more plastic in their reactions to the inorganic and non-social environment. If the environment is very adverse complex plant communities cannot develop and the initial stages remain as the final stages. There is no real succession at all. The same applies to human communities. Pioneer men, like pioneer plants, tend to be smaller in numbers and very widely scattered. They are more plastic in their reactions to Nature, but they fail to be able to fit themselves into a social environment of any degree of complexity. They remain pioneers and must always strike out along new pathways. They are stifled by the atmosphere of our great cities. There are, however, many respects in which the development of human communities differs entirely from that of plant communities, and this is not surprising, for the human environment is as different from the plant environment as men are from plants.

*Autecology* is the term applied to the study of the individual

plant throughout its life-history, from the seed through seedling, juvenile, adult, flowering, and seed-producing stages, all as influenced by its environment. This type of intensive study has proved very fruitful in plant ecology. In human ecology similar studies have also been undertaken, but many more are required. In every different type of human community the individual members pass through stages of infancy, early childhood, later childhood, adolescence, youth, middle life, and old age, and there are important transitional periods between them. The process of adaptation to the social environment is a continuous one. From this standpoint the whole of the literature dealing with education may be classed largely as autecological. It is a literature which deals mainly with civilized communities, but recently an increasing amount of interest is being taken in the educational methods of primitive peoples, a subject which will be discussed more fully later.

In plant ecology autecological studies have led on to the classifying and comparing of plants of different ecological types, known as growth forms, life-forms or more simply, plant-forms. The earliest classification by Warming was made to depend on the plant's relationship to its water-supply, e.g. xerophytes (adapted to dry conditions), hydrophytes (adapted to water life), mesophytes (adapted to ordinary life on dry land without extremes of dryness or wetness). Raunkiaer devised a system which depends on the plant's response to the winter resting season, which is undoubtedly one of the most important of the general distinctions that can be drawn between different climatic regions. Neither of these well-known systems, however, laid sufficient stress on the importance of the living or social environment, or on the complexity introduced by plants living together in communities.

In general terms, ecological classification of living organism must be made to depend on the mode of life of the organism in relation to the environment. An ecological classification of mankind, one of the tasks to be undertaken in later chapters of this work, must be based on differences in the mode of life of different types. The most essential thing for all men is the procuring of food. Man must eat at fairly frequent intervals. The methods

which he adopts to meet this necessity are sufficiently varied, so that the ecological classification of human beings may primarily be based on their relationships to their food-supply; though there are many other environmental factors which exercise an important ecological influence on mankind and the social environment in particular, it is fully recognized, is of supreme importance.

The view-point of plant ecology being, as already explained, entirely holistic, ecology has had a rather wonderful unifying effect, in its application to the whole study of botany. The aim of ecology is to explain, as fully as possible, how and why plants or animals have come to be as they are, to behave as they do, and occur in the places where they are found. Plant ecology has drawn upon palaeobotany because it is impossible often to understand the present-day ecology of plants without studying their past history. The study of plant structure is obviously necessary before a real understanding of the relationship of function to structure can be obtained. The ecologist must know how to classify and name the plants with which he is dealing, and any field ecologist, therefore, must have a good knowledge of taxonomy and systematic botany. Plant genetics and the principles of heredity are clearly of great ecological importance. The study of pathology is entirely ecological; for disease in plants, as well as in animals, is due to maladjustment to the environment. Indeed, there can be no aspect of the study of plant-life that is without an ecological significance, since, as we have insisted from the outset, life, apart from the environment, is impossible. Plant ecology, then, is not a subdivision of botany, it is a view-point or, as already remarked, an attitude of mind. It is a view-point which, once adopted, is never known to be abandoned. It is not merely enthusiasm for a young and vigorous branch of science that causes all ecologists to be firmly convinced that ecology is not only an attitude of mind but is only the proper attitude for those who have to study life.

In order to afford an illustration of how the adoption of the ecological view-point works out in practice, perhaps the writer may be pardoned if he draws on his own experience as an ecologist working on the vegetation of South Africa. To begin with, attention was devoted to making the acquaint-



tance of a vast new flora, to the analyses of the types of plant community met with, to studies of plant succession and to many detailed comparisons, both morphological and physiological, of the different ecological types of plant community and plant form. All this occupied a good many years of very enjoyable work, but the results of such analyses are not of much concern to us at the moment. It is rather the synthetic results of ecological work which are to be emphasized, the way in which it brings together different branches of botanical science. Botanists, for more than a century, have been engaged in patiently investigating the probable evolutionary history of flowering plants. A large measure of agreement has been reached regarding at least the main trends, and in a general way the details have also been worked out for the separate families.

Now the study of the ecology of South African plants presented many interesting questions of plant distribution. At first they were very puzzling, but a solution of the difficulties became apparent when various probable lines of migration were investigated. Migrations have occurred along the mountain ranges, along the great river valleys, along the sea-shore, &c., in a general direction for the most part southward from the moister regions of the tropics. Migration of the temperate element of the South African flora has also taken place northward along the great mountain ranges, connecting with the temperate vegetation of the Northern hemisphere. By combining the study of phylogeny and evolutionary history with the study of migrations, it became apparent that the moist tropical flora of Africa is the oldest. It is the great reservoir of plant life from which the whole tropical and sub-tropical elements of the South African flora have been derived.

The ancient moist tropical flora of Africa, in many respects, is closely similar to the moist tropical flora of South America and the rest of the tropical world in Asia. In early Cretaceous times, when there were no very highly elevated continents in existence, when there were no Andes, Himalayas, or Alps, and most of Europe was under the sea, the climate of such land areas as did exist was apparently warm and moist all over the world. All the earliest fossil remains of flowering

plants appear to have been of a moist tropical type. During the immense period of time that has elapsed since the beginning of the Cretaceous—some authorities estimate it as 100 million years or more—the moist tropical flora has remained under more or less unchanging and very favourable climatic conditions. Owing to the influences of the biota, owing to the effects of the crowding together of plants in dense forest communities and the resulting plant competition for space, the dominant trees alone have remained relatively unchanged. Below their canopy are a multitude of subordinate, derivative, and often highly evolved plant forms (climbers, epiphytes, shrubs, and herbs). Since the close of Cretaceous times, however, when there were initiated crustal movements and an upbuilding of continents, which led to climatic differentiation, the history of the flowering plants of the world has been mainly a history of response to cooler conditions on the one hand, and drier conditions on the other, of the earlier widespread moist tropical types.

Once this general principle was grasped the filling in of details for South Africa has been a matter of sheer delight. Every new fact discovered has fitted in to the general scheme. As one proceeds in imagination from the Congo to Karroo, one passes in review, as far as plant life is concerned, an outline of the history of the last hundred million years. The Congo tropical forest contains samples of the most ancient, the Karroo of the most recent angiospermous flora in the world. The temperate flora of the Southern hemisphere (Africa and Australia) though not so ancient as the moist tropical is also rather old, older, for instance, than the derivative sub-tropical South African flora, and older than the temperate flora of the Northern hemisphere, but this is a subject which is still receiving detailed attention. It is unnecessary to add more. Enough has been said to illustrate what ecology, in its synthetic aspects, stands for and what kind of results it is able to produce.

#### ANIMAL ECOLOGY

Though many studies of animal ecology were made before even the name ecology was invented, yet the systematic study of animal ecology is of more recent growth than that of plant

ecology, all the more general works on the subject, e.g. those by Adams (1913), Shelford (1913, 1929), Pearse (1926), Chapman (1926), Elton (1927), having been published during the last twenty years. The subject is still somewhat ill defined although, like plant ecology, it does aim at being synthetic and reducing to some sort of order the enormous accumulation of observed facts regarding the 'natural history' of animals and their habits and behaviour generally.

To do this successfully the same fundamental triad must be adhered to, environment—function—organism. The environment, in this case, however, has to be considered in a somewhat different way and emphasis must be laid on factors which are not of the same importance in plant ecology. In the fact of its later development, animal ecology has the advantage of having the way already prepared by the work done, by the plant ecologist, on the physical and chemical environmental factors. Temperature, water, light, soil conditions, &c., affect animals directly, but also, and to a great extent, indirectly, through the vegetation. The nature of the plant formations largely determines the character of the animal communities. This is exemplified by present-day animal distribution in all its detail, but, on a grander scale, throughout the geological ages, great changes in the world's vegetation have been followed by equally profound changes in the evolutionary history of the animal world. The differentiation among mammals, for instance, only became possible after the establishment of the world's great grassland areas.

Other animals, too, are a most important part of the animal environment. The inter-relationships of animals is a subject which has been studied from many view-points. First of all there is a huge literature dealing with inter-relations of animals belonging to the same species, with the social habits of insects, birds, and such mammals as live in flocks, packs, &c. The relations between the sexes in such cases, about which so much has been written, is all part of animal ecology. Division of labour among the social animals has provided a fascinating subject of study, and there is also a large literature dealing with ants, termites and bees, various birds (e.g. penguins), antelopes, and many others. The other type of animal

inter-relationship is that between members of different species. This is of a more general significance, since the very existence of so many animals depends on their ability to catch other animals for food, or to avoid being eaten themselves. It also includes animal parasitism, about which there is again a huge literature. The subjects of commensalism and symbiosis fall into their natural place, here, as well as animal coloration and mimicry. The vastness of the literature as a whole only serves to emphasize the importance of the holistic ecological aim, which is to reduce it all to some co-ordinated system.

The functional aspect of animal ecology differs both in degree and kind from that of plant ecology. There is, of course, much in common between plant and animal physiology but, on the other hand, there are many rather fundamental differences. The relationship between environment and function in animals (as compared with plants) is profoundly affected by the fact that most animals possess infinitely greater powers of active movement, and thus can change one environment for another, that the higher animals possess a central nervous system, and, most important of all from the ecological point of view, that animals cannot themselves manufacture food from simple gases and salts, but require to be supplied with food already elaborated, either directly or indirectly. The fact that plants can utilize light energy while animals depend on heat energy, is a fact of profound importance. A large amount of work has been done on the food habits of animals. Some of it, carried out in recent years, is relatively fundamental, for instance the work on deficiency diseases among domestic animals. This, as carried out in South Africa, provides a fine example of the economic importance of pure animal ecology, for the relationship of such diseases to the environmental factors was only brought to light by pursuing ecological methods.

From the standpoint of synecology, in the analysis of animal communities (i.e. all the species occupying the same habitat), a certain amount of work has been done on so-called 'food-chains' among animals, lower forms being eaten by higher and these in turn by still higher animals, often through many stages. The number of individuals of each species,



included in the chain, diminishes rapidly with succeeding stages.

The importance of the factors regulating the number of individuals of each species belonging to the whole animal community is fully recognized by workers on animal ecology. In the main they depend on food relations. Emphasis has been laid by one or two of the pioneers in this field on the necessity for studying not only the food relations of single species but the whole food cycle of the animal community. This, however, has only been done in a few cases, e.g. by Elton for Arctic regions, by Richards for the mammals of *Calluna* heath and pine woods in England, by Shelford in America, and perhaps by one or two others. Any proper ecological classification of animals will probably ultimately be made to depend on food habits. The primary division into carnivores (with which Elton would group parasites) and herbivores is, of course, a very ancient one. Each of these can be further subdivided according to their size, or the food they eat. The system of classifying plant life-forms, adopted by Raunkiaer, already referred to, depends largely on size in separating the main classes. For animals size is probably equally, if not more, important. With the elaboration of a suitable scheme of 'life-forms' depending on size, statistical methods similar to Raunkiaer's might easily be applied to the animal world as to the plant world.

If caution is necessary in applying the principles of plant ecology to the ecological study of man, perhaps it is even more so in the case of animal ecology. It is not always wise to go to the ant or the bee for guidance. The social animals have evolved under very different environmental conditions and their functional responses have little in common with those of human beings. It cannot be too definitely insisted that uncritical reasoning by mere analogy is very apt to lead to wrong conclusions, and, in general, it is not so much the results as the methods of plant or animal ecology that are useful in the study of human ecology.

#### HUMAN ECOLOGY

The value of human ecology, as in the case of ecology generally, lies in its synthesizing effect. It not only provides

a pattern into which may be fitted all the separate human sciences, but it affords a means of testing the relative value of each method of approach to the all important, all embracing, question of how and why man is as he is, and behaves as he does. It unifies all the human sciences and enables each one to find its proper place in a generalized study of man.

The term human ecology has already, from time to time, been used by other writers in a partial and less comprehensive way, and not always consistently. In some cases the environmental side has been emphasized in studies that are regarded as completely and essentially ecological, though, in fact, they only represent one special aspect of the subject. Human ecology has been regarded as a special branch of human geography. As we have already noted, others regard it as more or less synonymous with sociology, though that term (introduced first of all by August Comte in 1837, used by J. S. Mill and developed by Herbert Spencer) can at most only be regarded as synonymous with synecology. Other writers, particularly the physiologists, use the term 'biological' to represent the relationship between organism and environment. This term is too general, since biology is simply the science which deals with living organisms from any standpoint. It embraces both botany and zoology. Ecology, on the other hand, by derivation is a much more appropriate name and it emphasizes the environmental relationship in a way that the general term biological does not. Emphasis has already been laid on the many features in which animal ecology differs from plant ecology. Man differs from other animals mainly in being able to control his environment by intelligent effort to an amazing extent. His functional relationship to his environment is not merely physiological but psychological as well. Human ecology, therefore, has to include the study of man's mental processes and their results as well as his physiological responses.

#### THE PLAN OF THE PRESENT WORK

It is unnecessary in the present chapter to discuss more fully the outlook and content of human ecology. That will gradually be made clearer as we proceed, but it may be of

assistance if a very brief survey of the whole field is given at this early stage. There is a real danger that, in its attempt to draw upon all the different human sciences, human ecology may be made too diffuse and incoherent. Furthermore, it may fail to arrive at the properly integrated whole, at which it aims, by over-emphasizing, for instance, one or other of the separate terms of the biological triad, as many ecological treatises have done.

The plan that has been followed is, first of all, to deal with the environment, not entirely by itself, for that is impossible, but with only incidental reference to man and his functional responses. A proper analysis of both the non-living and living environment is all important. The non-living or physical environment is made up of many factors, each with its particular influence, and with all the factors interlocking and modifying one another's effects in a very complex way. Man's responses may be considered, in a general way, as an individual unit, or his separate physiological and psychological responses may be analysed in the minutest detail. Man's living environment includes the plants and animals which he comes into contact with, or makes use of, and also his fellow men or social environment.

Attention is next directed to the third term of the triad—to man himself. It is necessary to examine the results of modern work on man's heredity, and their bearing on ecology, before it is possible to understand one very important aspect of the general ecological problem of how man has come to be as he is. The next chapter is devoted to the relatively simple and straightforward problem of man's physiological responses to his environment; first of all to individual environmental factors; then to the environment as a whole; and finally, a brief summary is given of some of man's more important maladjustments to his environment which result in disease.

So far it is possible for human ecology to follow lines similar to those followed by plant and animal ecology. But, before man's active control over his environment can be discussed, it is necessary to interpolate another rather long chapter on man's psychology, and the relationships between psychology and human ecology. The biological triad is just as true for man's mental life as it is for his life as a whole.

Man's control over his environment is the subject which forms the main content of the cultural side of anthropology, and different methods of approach to the study of man's culture have to be examined in turn, and their separate aspects of usefulness to human ecology noted. It is then possible to proceed with man's ecological classification, starting, by way of introduction, with a chapter on ancient man and the subject-matter of archaeology, surveyed as far as possible (and very briefly for such a big subject) on ecological lines. The succeeding chapters deal with an outline of man's ecological and economic developmental history. The two terms ecological and economic are, in this respect, very nearly synonymous.

It is perhaps a little unfortunate that so much space must necessarily be devoted to this outline of the subject-matter of human ecology, for the concluding chapter of the book is essentially more important in that, a proper ecological outlook having been (it is hoped) obtained, it is then possible to examine many departments of man's intellectual activities, e.g. his literature, art, music, &c., from this new standpoint. It affords a new basis for criticism as applied to everything man has ever done, as well as to all that he is, both physically and mentally.

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## II

### THE ENVIRONMENT

Introductory—Physical Environment—Climate—Physical Features, Geological Structure, Soil Conditions—The Living Environment of Plants and Animals—The Social Environment—The Physico-chemical and Internal Environments—Bibliography.

#### INTRODUCTORY

WHILE it is true that the biological triad, environment—function—organism, must be studied as a whole, at the same time progress will not result if a too detailed, too distant view-point is always maintained. The environment cannot be effectively studied entirely by itself, without any reference to living organisms, but the biological triad can be regarded, so to speak, from the environmental end, as is done, for instance, in the study of human geography. From the ecological standpoint it soon becomes apparent that the functional relationship between environment and man is a very complex one. It is not simply a matter of man's responses and activities being determined by the climates and physical features of the earth's surface, or even by the resulting variations in the plants and animals of which man makes use, though it is on such aspects of the environment that geography rightly lays most stress. At primitive stages of his evolutionary history, and even to-day under primitive conditions of life, with lack of cultural development, man is most concerned with such *natural* environmental forces. For one reason or another, either because these forces are in themselves essentially too powerful, as in the case of tropical rain forest, on the one hand, and desert and arctic conditions on the other, or because he himself is too weak to alter them to any great extent, because of his low stage of cultural development, he remains a child of nature.

Ecologically the phrase is very significant and expressive. Primitive man is a child of nature, because for him the climatic and other inorganic environmental factors, together with the plants and animals on which he depends for his food, are all important. He accepts this environment more or less as it is,

and adapts himself to it, he makes use of it in a relatively passive way as a plant or animal does. Though even the most primitive types of mankind can influence their environment far more than any plants or other animals, yet, in the case of primitive man, the environment is the dominant member of the biological triad. As we have seen, it was only gradually that plant ecology came to assign its proper value to the social environment. Human ecology, as represented by the modern development of social anthropology and by the school of 'functional anthropology', has also come fully to realize the importance of this environment. Other social sciences such as sociology, economics, history, social geography are all concerned with the study of different aspects of it. Even for primitive men the social environment, though relatively a simple one, is far from unimportant.

Man does not live alone. He belongs at least to a family, the simplest of all the social units. The human baby, owing to its initial helplessness, has to be nursed and tended for a relatively long period as compared with other animals. The units of the family, father, mother, and children, are intimately bound together by social ties which are absolutely necessary to ensure the survival of the individuals. The family tends to expand into a larger type of social unit, through the attachment to it of other relatives or even dependants not related by blood, becoming the so-called extended family (*Grossfamilie*, *famille globale*, or *familia*), and such families may be united in still larger units such as the clan, tribe, or nation. As in the case of plant ecology, we may use the term *community* in a general sense, and apply it to any social unit, whatever its size or complexity. It is unnecessary at this stage, to discuss man's social environment more fully, but merely to emphasize its very great importance. It is the part of man's environment which will receive most attention in all the later chapters of this book.

We have already seen that there is no real distinction between plant ecology and plant physiology. In the case of man in the same way, human ecology includes the study of physiology and psychology. When man's various life processes and thought processes are considered, we find that, once more, it is quite impossible to separate these from the environment.

Physiologists sometimes speak of an internal environment. Food, for instance, after it is swallowed has to be assimilated, and, even after it is absorbed into the blood-stream, there are various chemical processes of oxidation, and energy changes of a most intimate character, continually going on. Even the structure of the body, though it appears to be more or less fixed and constant, is continually undergoing changes, in all of which the environment is involved. The easiest way, perhaps the only way, in which the life process can be interfered with, is by altering the environment. If, for instance, ecologically an adjustment to the environment is not perfect or normal, our sensations are affected. We *feel* ill. A doctor diagnoses the particular source of the trouble, the particular maladjustment, and prescribes a remedy. The medicine we swallow is designed to correct the maladjustment and restore the normality of the interchange between environment and organism, and it does so by changing the internal environment.

In our study of human ecology, it will be well for us, however, to begin with some of the more obvious and simpler of man's relationships to his environment.

As we have seen, the environment may be regarded from at least four different standpoints and can be divided therefore into the following four categories: (1) the physical environment (climate, geological structure, and soil conditions), (2) the living environment of plants and animals dependent, in their turn, on the physical environment, (3) the social environment (man's fellow men), and (4) the intimate physico-chemical environment and so-called internal environment. In this chapter we shall deal with some of the more general aspects of these, to be followed later by a more detailed study of some of man's responses to the different factors involved.

#### PHYSICAL ENVIRONMENT (CLIMATE)

In all modern text-books of geography the different climatic regions of the world are dealt with in greater or less detail. It is unnecessary in a work of this kind, therefore, to repeat much of what is to be found in such books. We shall aim rather at laying emphasis on the kind of facts which are



considered of most significance from the ecological standpoint. It need hardly be said, however, that all the facts have some significance or importance. It is unnecessary also, even if space limitations permitted, to attempt any very detailed system of regional classification of climates. The following examples are all sufficiently distinct.

1. *The Tropical Rain-Forest Region.* This extends through from 10–20 degrees of latitude, north and south of the equator and is best developed on the west and west-central regions of Africa and the east and central regions of South America, in the great river basins of the Congo and the Amazon. It is a region of moist heat, with remarkably little variation from day to day, or from day to night, or from season to season. The average temperature is between 70° F. and 80° F. and the range between the hottest and coldest months is rarely more than 5° F. The rainfall is high, 70 or 80 inches annually as a minimum, and usually a great deal more, and, as a rule, is fairly evenly distributed throughout the year, though there may be one or two periods of maximum rainfall. The atmosphere is always more or less calm and still, steamy and enervating. The vegetation consists of dense evergreen forest, the trees being tall, not much branched, with relatively slender boles and buttress roots, or 'plank buttresses' at the base. They are arranged in several distinct canopies, with abundance of climbing plants and epiphytes growing over them. On the floor of the forest the shade is very dense.

Tropical rain-forest is not very rich in animal life. For the higher types of animal a suitable food supply is limited, and relatively few mammals inhabit the denser types of rain-forest. The majority of all the mammals are either grass-eating or are carnivores that prey on herbivores. In addition to the purely forest types, some of the others, however, both herbivorous and carnivorous, shelter in forest, though they wander outside into more open areas to feed.

In the densest types of tropical rain-forest, under such favourable conditions for plant life, Nature, as already remarked, proves too strong for man to conquer to any appreciable extent. One of his most potent agencies for destruction, fire, proves relatively ineffective, for the forest is mostly too

wet to burn. The dominant trees are of a very hard-wooded type and cannot easily be felled. Man is forced to accept conditions as they are and, adapting himself to them, make what use of them he can. Social development under such conditions cannot proceed very far, and, under natural conditions, tropical rain-forest is inhabited only by human beings of a very primitive cultural type, e.g. the pygmies of the Congo and various Indian tribes of the Amazon. As we shall see later, however, these have succeeded in adapting themselves to this environment very successfully, as hunters and food collectors.

Where the rainfall is not quite so high or so constant, and the forest not so dense, destruction of the forest is possible, and man is able to practise a primitive type of agriculture or (to be more accurate) of hoe-culture or gardening in forest clearings. Tropical food plants are easily cultivated and in many regions cultivation can be carried on more or less all the year round. The growing of plants for food leads to more settled habits and increasing complexity of social organization. Primitive trading between different agricultural communities, and between the hunting and agricultural types inhabiting the same regions, has grown up, the former, for instance, supplying the meat or skins of wild animals in exchange for fruit, cereals, or other vegetable products. Closer contact between different ecological classes of mankind has also often led to conflict, warfare, and slavery, the underlying reasons for which have all to be analysed on ecological lines.

While trading within the tropics themselves must always remain relatively primitive and unimportant, for the simple reason that the needs of the inhabitants are few, and can be satisfied from their immediate environment, yet, under modern conditions, the tropics are necessary for the production of certain raw materials and foodstuffs demanded by the highly complex civilized communities of the temperate zones. Rubber, cocoa, palm-oil, copra, ivory, and rice are some of the more important examples. The production of these in the tropics, on an extensive scale to supply the needs of the whole world, has introduced infinite complexity into the study of human ecology in moist tropical regions. The natives, by

themselves, and if left to themselves, cannot make sufficient use of the natural resources of their environment to satisfy the world as a whole, and the white man and other non-tropical races have in consequence invaded this climatic region, to which they are not primarily adapted. In human ecology many things have to be studied to which there is no exact parallel in plant or animal ecology and the life of the white man in the tropics is a case in point. It illustrates also the special economic importance of the subject.

2. *The Tropical Grassland Region.* This lies on either side of the rain-forest region, between it and the desert regions. Here there is much greater variation in temperature between the hot and cool seasons and between day and night. The average annual rainfall varies from as low as 15 inches near the desert areas up to 70 or 80 inches or more and there are distinct wet and dry seasons. The rain falls in spring and summer, the winters are dry. There is thus a distinct winter resting season for the vegetation, which consists of great stretches of grassland with scattered trees, or small patches of forest, giving a characteristic parkland type of scenery, or of pure grassland without trees, or, as the region merges into desert, of dwarf shrubs and bushes with scattered tufts of grass. Animal life in this region is usually abundant, both herbivorous and carnivorous. Under natural conditions, the inhabitants show various degrees of ecological progress. Some remain hunters and food-gatherers, though these, in modern times, tend to be driven to the outskirts or less favourable areas, i.e. towards the forests on the one hand and the desert regions on the other. Agriculture as practised in the region remains hoe-culture, and is nearly always the work of the womenfolk. The great stretches of treeless grassland are not, as a rule, cultivated at all. The forest destruction method is again pursued, so that the spread of the interspersed forest areas through the grassland is constantly being kept in check. The burning of the growth of timber, to make a clearing for a garden, leads to a temporary enriching of the soil, but it soon becomes exhausted by cultivation, and has to be abandoned, when a new site is selected and the process repeated. Nowhere in the tropics has man ever carried out agriculture on an extensive scale over large areas of

grassland, and, even in temperate regions, it is only very recently that he has begun to utilize the richest grassland areas of the world, e.g. in Russia, Canada, United States, and the Argentine.

In addition to the practice of agriculture, in the tropical grassland regions man has become a pastoralist, since the enormous areas of natural pasturage are capable of supporting large herds of domestic animals. The inter-relationships between hunters or food-gatherers, agriculturalists and pastoralists have all to be investigated by human ecology, and their study throws a great deal of light on the fundamental question of how man has come to be as he is and to behave as he does. While some communities belong to one of the classes and one only, being purely food-gathering or agriculturalists or pastoralists, other communities may combine two of them, e.g. hunting and pasturing or pasturing and agriculture. Hunting and the pasturing of animals are usually the work of men, food collecting and hoe-culture the work of women, but, in some of the more complex and stratified communities, agriculture may be the work of a peasant or slave class, which is not allowed to possess herds of domestic animals. The ways in which stratification has been brought about will be considered at a later stage.

Tropical grassland areas are not, as a rule, densely populated, and are not yet extensively made use of to provide the world as a whole with any raw materials required by manufacturers.

3. *The Tropical Monsoon Region.* This region embraces India, Indo-China, and southern China. It is similar to the last type, with wet summers and dry winters, but the rains come later in the year and are of the 'monsoon' type. The winds blow from land to sea in winter and from sea to land in summer, corresponding in a seasonal manner, and on a much larger scale, to the land and sea breezes of coastal areas elsewhere, which depend on the alternation of night and day.

The amount of annual rainfall in the monsoon climatic region varies greatly, from less than 5 inches up to more than 80 or, under the influence of relief in the mountain areas near the coast, up to as much as 500 inches. The drier parts have a very great range of temperature, the wetter parts a smaller.



The vegetation varies also according to the rainfall. The wetter parts are clothed with dense evergreen forest, not very different from tropical rain-forest. Areas with a rainfall of 40–80 inches have deciduous forest, areas with 20–40 inches thorn forest and scrub, and areas with less than 20 inches are transitional to desert.

The soils of this region are often very rich, the vegetation is more easily cleared than in the tropical rain-forest region and the population is mainly agricultural. The region is one of the most densely populated in the world.

When a population has led a settled life for a long period of time and has developed its agriculture and general methods of food production as far as possible, an indigenous civilization can slowly be built up. In India this has been, in the course of its history, greatly modified by the incursions of invading peoples and subsequent rearrangements, its own peculiar environment exercising a profound influence throughout. As far as the food supply is concerned at the present time, in the wetter parts rice is the main crop, with or without irrigation, while maize, sugar, and oil seeds are also grown. In drier areas millet is the chief crop, together with wheat, barley, oil seeds, and cotton. The drier areas often suffer from famines if the monsoon fails.

4. *The Mediterranean Climatic Region.* The Mediterranean type of climate occurs in the regions around the Mediterranean sea, between latitudes  $30^{\circ}$  and  $45^{\circ}$  N., as well as in California, Chile, South-western Cape Province, and Australia i.e. mainly on the western sides of the continents, characterized by having hot, dry summers and moist, mild winters. The rainfall usually varies from 10 to 40 inches, but in places is much more. The vegetation is of the type known as Maquis or Macchia, made up of evergreen, deep-rooted, small trees and shrubs, with the usual admixture of herbs and undershrubs. Grasses are common enough, but they grow in isolated tufts and patches, and do not form grasslands. The flora is a rich and varied one. The vegetation, from the ecological view-point, is described as sclerophyllous, with hard leathery leaves or heath-like ericoid leaves or with other xerophytic modifications. This is in response to the fact that the dry season is also the hot season. The characters

of the vegetation, however, on which stress should be laid, are the prevalent deep roots, which penetrate down to the permanent water table, and the fact that the trees and shrubs are evergreen, in which respect they show their ecological affinities with the vegetation of the tropics. The winters, though rainy, are not, for any long intervals, cloudy, since the rain storms do not last long, and there are long, bright, sunny intervals in between. The climate is well suited for the cultivation of various cereal crops and particularly for the ripening of most of the common fruits. Fruit growing is one of the most important industries in all parts of the world where this climatic region occurs. Regions with winter rainfall are not so well suited for the pasturing of domestic animals.

The Mediterranean region itself has produced many of the great civilizations of the world, though it must be remembered that, possibly even within historical times, and certainly during prehistorical times, when man was already in full possession of the region, the climate was considerably wetter and cooler than it is now. When the more northerly areas of Europe were all covered with ice, the cyclonic storms circling round that great ice sheet must have made the climate of the Mediterranean region very similar to what the climate of England, France, Germany, and the rest of western Europe is now.

5. *Desert Climates.* Hot deserts occur in tropical and subtropical regions where, owing to high atmospheric pressure, the winds blow outwards and no moisture-laden winds come in from the ocean. The greatest of them all is the desert which stretches across North Africa (the Sahara) and continues over Arabia to Baluchistan and the Indian desert. In Australia there is another large desert, while in South Africa a relatively narrow strip along the west coast (the Namib) is the only purely desert area, the so-called Kalahari desert being, at the present time, a sandy grassland area rather than a true desert, though it is covered by sand and has, therefore, in spite of a moderately high summer rainfall of 5-15 inches, little or no available surface water. Smaller hot deserts occur also in Mexico and on the United States border, and in Peru and North Chile between the Andes and the sea.

Temperate deserts cover enormous areas of Central Eurasia and large tracts of North America, while there is a Patagonian desert in South America.

The vegetation of desert areas is very scanty, the scattered plants being usually succulent or thorny or both, and extremely xerophytic. Their vegetative parts are sometimes strongly scented. Over great sandy areas no plants of any kind are to be found, but, on the other hand, here and there fertile oases occur where cereals or date palms are cultivated. The larger oases may support a considerable population. Elsewhere the desert is uninhabited, except for bands of nomads who use the camel to transport goods to and from the oases or across the desert. While the summers are generally intensely hot, especially in such regions as the Arabian desert, where the highest naturally occurring temperatures in the world have been recorded, the winters in temperate deserts may be very cold. Temperate deserts are exploited mainly in regions where minerals are found.

6. *Temperate Climates.* Various sub-types of these are to be distinguished.

(a) The Warm Temperate Climate occurs mainly on the east coasts of the continents. It has summer rainfall, but is not so warm as the Monsoon climate. The natural vegetation is forest, but it has often been completely cleared, as in China, which is even more densely populated than India. Cotton, rice, and tea are the chief crops, while the mulberry tree supports the silk-worm. As in the case of India, the over-populated areas suffer from periodic famines, either due to drought or to disastrous floods.

(b) The Cool Temperate Oceanic Climate supports the highest type of the present-day world's civilization in Europe and North America. In the Southern hemisphere, New Zealand, Tasmania and southern Chile have this type of climate also. It is distinguished by having a not very great range of temperatures, a well-distributed rainfall throughout the year, and the winds blowing in a series of cyclones. These cyclonic storms provide continual changes in weather conditions. There is no monotony about this type of climate. It is a type which apparently has proved most stimulating and favourable for man's development, both physically and

mentally. Under such conditions he is capable of displaying the greatest amount of energy and performing the greatest amount of work. The natural vegetation of the region is deciduous forest with coniferous forest on the highlands and, along the western sea-board of Europe, large areas of moorland with evergreen heathers dominant. But the region is densely populated and, especially in the neighbourhood of the large cities, there is often little of the natural vegetation left. The cool temperate climate of the east coasts of the continents (North America and Manchuria) differs from that of the west coasts in having the winters far colder and the summers hotter.

(c) The Temperate Continental Climate is the climate of the great temperate grassland regions of the world, the Steppes of Russia and Asia, the Prairies of North America, the Pampas of South America, and such of the South African grassveld as occurs at higher altitudes (the rest of the grassveld being rather sub-tropical). These regions are warm to hot in summer, very cold in winter. The rainfall comes mainly in spring and summer. Temperate grasslands are, at present, more densely populated than the corresponding tropical type, but here, too, primitive man is, or was, either a hunter (e.g. the Red Indians of the North American prairies) or a pastoral nomad (e.g. the Mongols, Tartars, Kirghises, Turcomans, &c., of Asia). Under more civilized conditions a more settled kind of pastoral life is still pursued, on the great sheep and cattle ranches of the white settler in these regions (e.g. in the Argentine), where the natural grasses are still utilized. But this kind of pastoralism will probably soon become a thing of the past, for the present-day tendency is to bring as much as possible of the temperate grassland areas under cultivation. These regions have in recent times become the great granaries of the world; wheat, barley, oats, rye, maize, and other crops being grown. In addition, with advances in scientific methods of agriculture, the tendency is to grow food for domestic stock rather than to make use of untilled pasturage. The agriculturalist, everywhere (except under certain special modern economic conditions), tends to oust the pastoralist. With increase of population this is inevitable, since better use of the soil pro-



vides for a much denser population. The soils over great areas are rich but, with continued cultivation, require manuring after a time. The modern scientific use of chemical fertilizers, as well as the using of motor machinery and up-to-date scientific methods of farming generally, has, in recent years, been exercising a profound influence on the economic life of the inhabitants of these regions.

7. *The Cold Temperate Climate.* This is the climate of the Northern Coniferous belt and also of mountain ranges above a certain altitude elsewhere. It occurs also in the extreme south of South America and on the mountains of New Zealand. During the long winter precipitation is mostly in the form of snow. Oats and barley are the only cereal crops grown. The primitive inhabitants of these regions are hunters and trappers. The animals are protected against the cold by fur coats and the main fur-producing countries of the world are Canada and Siberia. The coniferous forests are the world's main source of soft-wood timber and the wood pulp used in paper-making.

8. *The Tundra or Cold Desert Climate.* This lies within the Arctic circle, where the winters are very long and very cold and, for a period at least, quite without sunlight. The ground is frozen for eight or nine months in the year. The summer is short but warm, with a period of continuous sunlight. The vegetation consists of lichens, mosses, and a few dwarf shrubs and herbs. In the short summer, grasses and other herbs grow quickly. The reindeer or caribou is the common animal. The region is very sparsely inhabited in North America by Eskimo, who live by hunting or fishing. The seal, the whale, the walrus, or the caribou are hunted. In the old world the tundra regions are inhabited by various Hyperborean nomads (the Chukchis, Koryaks, Tunguses, Lamuts, Ostiaks, Samoyedes, Zirians, and Lapps), who have domesticated the reindeer. All these peoples will be dealt with more fully in a later chapter. Northwards the tundra passes into the regions of permanent ice and snow.

*Changes of Climate.* Such in outline are the present-day conditions of man's climatic environment. We have noted in passing, that while some of the climatic types, such as tropical rain-forest, have remained more or less unchanged

since remote geological times, other climates have repeatedly altered. There is good evidence for climatic fluctuations, climatic cycles and shiftings of the storm tracks, even within comparatively recent times, a fact which many geographers believe has profoundly influenced man and has been the primary cause of many of his migrations. Moreover, palaeolithic man lived through several still more profound climatic changes, when ice periods alternated with periods of warmth or wet periods with arid. Now long-continued uniformity of climate is not necessarily to be correlated with long-continued stagnation in man's development. Just as among animals and plants evolution can proceed, though external conditions remain more or less unchanged, as is shown by the evolution of life in the sea, so, as regards man, and particularly as regards his culture, there is no reason why he should not have progressed, even though he had no need to adapt himself to new and changing climatic conditions. Though this is true, at the same time it is reasonable to suppose that an unchanging climatic environment will lead to relative stability or stagnation in man's habits and culture, while, on the other hand, changing conditions will either lead to his evolutionary progress or, failing that, his destruction. There is room for a great deal more work on this question, but, in a general way, it seems to be the case that the regions of relative climatic stability in the world are also the regions where man has remained, for the longest period of time, at the same, and that a relatively low, level of culture. It is not, however, to be assumed from this that he originated, i.e. was evolved from his ape-like ancestors, under such conditions. This is a question to which we shall return later.

#### PHYSICAL FEATURES, GEOLOGICAL STRUCTURE, SOIL CONDITIONS

While man's behaviour and activities are largely determined or modified by the general climatic conditions, and vary according to the differences exhibited by the different climatic regions, they are also dependent on the physical environmental factors, which in turn modify the climatic factors as well. Within all the tropical regions, climate changes with increasing altitude, giving, in the case of the

higher mountains of the tropics, a complete range from moist tropical to cold temperate and cold desert.

Over the large regions in the tropics great elevated plateaux possess climates that may be regarded as of a temperate character. The importance of aspect or relief is also very great, especially in smaller areas. A slope which faces south is under entirely different climatic conditions, as regards the light and heat of the sun, from a similar slope which faces north. In South Africa, for instance, where the writer has carried out many observations and experiments on this subject, the northern slopes (facing the sun) have a much more tropical and xerophytic vegetation than the southern slopes. This applies, of course, to both hills and valleys. The various factors of light, temperature, and humidity and the processes of plant transpiration, &c., have been measured instrumentally, but the difference in insolation can also be calculated mathematically. Roughly, a slope with an angle of 30 degrees to the horizontal and facing north in the latitude of Pietermaritzburg is equivalent to a shift of 15 degrees of latitude northward.

As far as man is concerned, attention to this factor affords a reasonable explanation of why the inhabitants of one side of a river valley (or mountain range) may differ considerably, in their habits and work, from the inhabitants of the other side.

The physical features of any region are determined by its geology (present geological structure and past geological history). A full understanding, therefore, of the orography and topography of a region can only be reached by a study of its geology. Man's work and general activities are differentiated within each climatic region mainly by topographical differences. This is perhaps most apparent when he utilizes the mineral wealth of the earth, and only slightly less so when he cultivates the soils of the earth's surface to produce his different kinds of crops. Under the most primitive conditions of life as a hunter and food collector man is still more dependent, as we have seen, on the natural features of his environment.

For purposes of illustration the river basin may be selected. It is the familiar unit commonly dealt with by

workers on 'regional surveys' on the lines of the Le Play and Geddes schools. In mountainous regions, near the river's source, man commonly lives as a hunter or trapper, making use of a more or less unmodified environment. In the forest region lower down he is a woodsman or timber worker; still lower down on the slopes of the foothills he is a pastoralist, with his flocks of sheep or herds of cattle; on the flat plains of the river basin he is an agriculturalist, growing cereal crops. Wherever minerals are found he becomes a miner, while at the river mouth, or sometimes along its banks, he becomes a fisherman. The relationship between environment and function is thus clearly demonstrated.

The process of man's adapting himself to the more general climatic and physical features of his environment has been a gradual one, spread over the whole period of his evolutionary history. While the increase in modern scientific knowledge has made it easier for him to control his environment, yet, in many ways, the most primitive types of living mankind are as well adapted to their own environment as are the most highly civilized. It is, however, rather a remarkable fact that it is only in recent times, during the last two centuries at most, that man has begun to react ecologically to soil conditions in a reasonably intelligent manner. The cultivation of plants is itself a comparatively recent accomplishment on the part of man, but, even after the first beginnings of agriculture were made, it took a long time for man to realize the importance to him of knowing something of the different types of soils.

Primitive man, as we have seen, still commonly prefers to pursue laborious and unsatisfactory forest destruction methods in agriculture rather than utilize open grassland soils, while the richest soils of the world have been entirely neglected until modern times. Even the scientific study of soils by civilized man has only quite recently been undertaken on proper lines, and the full ecological importance of modern work on soils is by no means as yet generally recognized. Yet the economic importance of it all can hardly be exaggerated. The processes of soil formation and the close interdependence of soil conditions and climate (particularly the climatic factors of rainfall and temperature) are now



becoming more fully realized, and the classification of soils is based thereon. Mature soils are the result of soil forming or 'pedogenic' processes which act on materials varying according to the nature of the original rock from which they are derived, the processes themselves being often so greatly modified by the climatic factors as to obliterate all differences due to the original materials. This is hardly the place to enter into further details concerning modern soil science, which may be obtained from such works as those of Ramann (1911), Glinka (1914), Marbut (1928), or Robinson (1932), but it may be remarked, in passing, that it illustrates very well the complexity of the whole environmental problem. Though climate and soils can be separated as environmental factors, yet they are so interlocked and their inter-relationships so complicated that, after all, it is perhaps not altogether surprising that the proper study of soils and their relationships to climate should have remained so long neglected.

*The Living Environment of Plants and Animals.* The interdependence of the plant and animal life of the world and the factors of the physical environment, which is the subject-matter of plant and animal ecology, has already been sufficiently emphasized, and illustrative details have been supplied for each of the climatic regions above considered. On the other hand, man's relationship to the plant and animal environment is profoundly modified by his degree of social or cultural development, i.e. by his social environment. Though the different aspects or categories of the environment may with advantage be considered separately, their close connexion with one another is, all the time, very obvious. In this place, it will be sufficient if a brief summary is given of the uses made by man of his living environment as follows:

(a) Primitive man who has not passed beyond the food-gathering stage of cultural development lives as a hunter or fisherman (mostly the work of men) and a food collector, gathering wild tubers, bulbs, roots, &c., or shell-fish (mostly the work of women). For the long period of time known as the palaeolithic, while mankind was very slowly building up the earlier stages of cultural progress, this was the universal mode of life. At the present time such food-gathering types

occupy forest regions, semi-desert regions, arctic regions and sea-shore habitats, types of natural environment which have been left untouched and unmodified by more advanced types of mankind. The mode of life in all its details, the general physical and mental behaviour and reactions (which will be fully discussed in a later chapter) of these food-gatherers show a very close and successful adaptation to their plant and animal environment on which they are dependent for their existence.

(b) Agricultural peoples are socially much more advanced, since, by bringing plants under cultivation, a much larger population can be supported in the same area. The methods of cultivation and the plants cultivated differ according to the nature of the physical environment, in which mankind now takes a greater direct interest. Rainfall at the proper seasons, for instance, becomes a factor of vital importance and the psychological reactions to all the different seasonal changes have had a profound effect on man's primitive beliefs in magic and religion and, through these, on his relationships with his fellow men.

(c) Pastoral modes of life demand the wide open spaces of the great grassland or shrub-plain areas of the world, and are, therefore, determined primarily by the physical environment. Man's relationship to his domestic animals, however, is a still more intimate one. They are his source of both food and clothing. They must be tended and usually milked and moved about for pasturage. Mobility is essential as well as habits of discipline, which have led on to fighting habits when new feeding grounds are in request. The psychological outlook and general behaviour of the pastoralist differ widely from those of the agriculturalist, but both these as well as the relationships between the two types will be dealt with fully in later chapters. For one reason or another many peoples have come to combine pastoralism, or at least the keeping of domestic animals, and agriculture and the former are used not only as a source of food and clothing but in the developing of the latter, by their assistance in the use of the plough or for transport purposes.

(d) With the growth of civilization and the complexity of social organization, as for example in modern cities, man



ceases in many cases to have a very close relationship with the plant and animal life of the world, though the stage has not yet been reached when foodstuffs can be manufactured, on any large scale, directly from the gases of the atmosphere and mineral salts of the soil, without the help of plants. Even at a fairly early stage of man's cultural development, miners, metal workers, and craftsmen of various kinds performed necessary services to the rest of the community, in return for which they were supplied with food, and, in all types of 'stratified' communities, rulers, priests, professional and military classes, &c., are not primarily concerned with plants and animals. Yet all share a common heritage and the living plant and animal environmental impress has been deeply stamped on all members of the human race. This is illustrated by the desire exhibited by practically all normally constituted men and women, who, under modern conditions, are forced to give most of their time and attention to other kinds of work, to return, on occasion, to a simpler mode of existence which they regard as a relaxation, e.g. hunting, fishing, or gardening. Outdoor life in general and particularly life near the sea-shore, where man, at various stages of his evolutionary progress, has taken up his abode, has the same kind of appeal. From the beginning of his history, his living environment has profoundly affected man's feelings and emotions and general psychological outlook. A proper understanding of the literature, art, music, religion, and indeed all the work of men's minds, can only be attained if this simple ecological fact is definitely recognized and appreciated.

(e) Apart from the uses he makes of the plants and animals of the world, man is also affected by insects, parasites of various kinds, protozoa, fungi, and particularly by the bacteria. Emphasis should be laid on the fact that some of these are absolutely essential for the continuance of his existence, together with all other forms of life. The bacteria are necessary to keep up the circulation of nitrogen in nature and to provide for the decomposition of dead organic matter. Other symbiotic relationships of man and lower organisms are necessary or beneficial, but, on the other hand, the disease-causing organisms interfere with his normal physiological

functioning or bring about death. Further reference to this aspect of man's environment will be made in a later chapter.

#### THE SOCIAL ENVIRONMENT

Man's social environment may be regarded from two standpoints, the one synecological the other autecological. In the former case organized society, as represented by the community, large or small (state, tribe, clan, or family), is studied and analysed. The individual is regarded as a unit in this society and his separate existence, apart from his social environment, is not under consideration. In the latter case the individual is studied as regards his life-history, in all its different stages, from birth through infancy, childhood, youth, middle age, and old age to his death, as influenced by the community to which he belongs. The distinction is an important one, even though it is only between different viewpoints. It applies not only to primitive communities but to modern states, and it represents the fundamental difference between opposing political theories. Some regard the state as always supreme, with absolute power, allowing only a certain degree of freedom to the individual and no more. Others regard individual freedom as the main consideration allowing the state only such a degree of control as will be necessary for the good of all.

It is the business of human ecology to review all the facts and to analyse all the different types of social organization of varying stages of complexity and development, as well as to determine the effects on the individual. As we have seen, man, at the most primitive food-gathering stage of cultural development, is most concerned with his physical and living (plant and animal) environment. His social organization is of a simple type, consisting of the family, enlarged family or small clan or tribe. Even at this stage and especially when the environment is a harsh one, making the obtaining of food a difficult matter, tribal unity or solidarity is found to be of supreme importance, and the freedom of the individual is subordinated to the welfare of the tribe or other communal unit. This is very clearly demonstrated by the customs and social organization of the Australian aborigines. Under

more favourable environmental conditions communal ties are often somewhat looser. In many cases the individual is given more liberty and the individuals are more on a footing of equality.

The introduction of agriculture and the domestication of animals at once led to larger social units and greater complexity, giving an opportunity for more leisure and the development of various arts and crafts, which in turn led to the members of the community becoming separated into guilds or castes, and in general to a stratification of the community. The growth of the fighting spirit, with man carrying on warfare against his fellow man—a feature in which he differs from most other animals, since they fight usually with other species—increased the necessity for tribal unity and also increased the complexity of social organization, being one of the main causes of the institution of slavery or other types of subordination of one tribe to another.

Throughout man's history it would seem that there have been many alternations between the two somewhat opposing ideals—the freedom of the individual and dominance of the community as a whole. The determining of the exact environmental conditions which favour the one or the other is one of the tasks which human ecology must undertake. There is never, of course, complete freedom allowed to any individual who is a member of a community. No one is allowed to do exactly as he pleases, and the ways in which his liberty is circumscribed are varied and often very subtle.

This can, perhaps, best be brought to light by the autecological method of approach. Instead of beginning with the community as a whole, the life of the individual is studied. His whole life-history is a process of learning to adapt himself to his environment. Some of it takes place in a more or less unconscious and automatic way, the learning process being made possible and necessary by his inherited constitution. A great deal of it on the other hand has to be taught and the community sees to it that each member is taught the right things at the right times.

In plant ecology the study of plant successions, i.e. the development of plant communities, has been fruitful of results. The study of communal development is equally

important in human ecology. A certain amount of information regarding the general evolutionary history of human communities has already been given and more will follow, but, in this place, it may be pointed out that man, living in the more advanced types of civilized communities, by a system of co-operative effort, has succeeded in controlling his physical environment to a truly astonishing degree. His environment becomes more and more an artificial one—the result of his social activities. It is an environment which he constantly maintains, adds to, alters, or occasionally more or less completely re-makes. The social environment is obviously a very complex one and also very varied. The different communities into which mankind has become grouped vary according to their physical environments and according to their stages of evolutionary development. The relationship between different communities is, therefore, also to be studied by human ecology. Here the history of trade and other friendly relationships and the history of warfare or general inimical relationships both find a place and both have had very far-reaching results. Just as the individuals within a single community, by co-operative effort and division of labour, have increased the efficiency of the community as a whole, so also separate communities, by supplying one another's needs in a reciprocal way, have furthered the progress of civilization and increased man's general control of his environment. On the other hand, as the result of warfare, some communities have become dominant over others or have completely absorbed others, thus leading to an increased size and complexity in the larger nations—a process which is not analogous to the natural growth of plant communities, but nevertheless has often led in the end to a higher type of climax formation.

*The Physico-chemical and Internal Environments.* The impact of the environment on the life processes, as studied by the physiologist in his laboratory or in the field by instrumental methods, is of fundamental importance to the ecologist. It is rather the functional aspect—the second member of the biological triad—that is here to be reviewed but there are a few aspects of the physico-chemical environment itself which deserve attention in this place. A book published



more than twenty years ago, by L. J. Henderson (1913) on the *Fitness of the Environment*, laid emphasis on the many unique properties of water, carbon dioxide, the elements carbon, oxygen, hydrogen, nitrogen, and their compounds which enter into the life-processes in the ocean, pointing out that no other environment made up of other primary constituents could possibly possess anything approaching the same number of characteristics fitted for life as we know it. On general grounds this is naturally to be expected, but none the less, when the wonderful fitness of the environment is followed out in all its details, the total result is exceedingly interesting. To select only one example out of a multitude, if water did not possess the unique property of expanding before freezing, ice would not form first on the top of sheets of water, but from the bottom upwards and during winter in colder regions, rivers, and lakes would form solid masses of ice which would take so long to melt in summer that large regions of the Northern hemisphere would be rendered more or less uninhabitable. More intricate details regarding the thermal properties, dielectric constant, solvent power, surface tension, &c., of water, or absorption coefficient, strength as an acid, &c., of carbon dioxide and other similar observations are equally impressive.

The study of this aspect of the environment is assisted by paying attention to the concept of 'limiting factors'. When any physiological process of interchange between environment and organism is investigated it is found that it is the necessary factor of the environment which is present in the least amount that controls the rate of the process. The idea can be extended and applied to general ecology as well as to single physiological processes. Thus water is usually the limiting factor for man and his activities under desert conditions, temperature in polar regions and sometimes in very hot regions, oxygen on high mountain ranges, and food supply under a variety of environmental conditions, e.g. small oceanic islands. In connexion with ecological classification a similar idea has been made use of but in a somewhat more flexible way, by selecting one so-called 'master-factor' of the environment as a basis for differentiation. Warming, for instance, classified plants ecologically according to their

water relationships, thus selecting water as the 'master-factor'. Raunkiaer on the other hand, chose response to the winter resting season. For the ecological classification of mankind, as we have seen, the most suitable master-factor is food supply.

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### III

## HEREDITY AND ECOLOGY

Introductory—Heredity and Evolution from the Ecological standpoint—  
Human Heredity and Ecology—Eugenics—Bibliography.

#### INTRODUCTORY

**B**EFORE man's responses to his environment can be profitably discussed in greater detail, it will be necessary to devote the present chapter to a closer examination of man himself and his hereditary constitution. In other words we must now approach the biological triad from the opposite end. To do so is not altogether a simple matter, for we must first of all make ourselves acquainted, at least in outline, with modern ideas regarding evolution in general and man's heredity in particular. The study of the evolutionary history of his physical characteristics, while not without its own ecological interest, may be postponed until the ecology of early man is discussed.

#### HEREDITY AND EVOLUTION FROM THE ECOLOGICAL STANDPOINT

The idea of evolution goes back to the Greek philosophers. Osborn (1895) has given us a very vivid account of its historical development up to the time of Darwin; Darwin himself, in the *Origin of Species*, dealt fairly fully with the views of his predecessors, and most of the works on the subject, listed in the Bibliography to this Chapter, not only deal with the special schools of evolution which each favours, but criticize or amplify the work of other schools as well. The whole literature of evolution, since Darwin, has become too enormous for any single mind to attempt to assimilate completely. Darwin's work brought about a revolution in human thought, so that, as Osborn says, 'Before and after Darwin' will always be the *ante et post urbem conditam* of biological history, even though the evolutionary idea is so much older. Nevertheless, though to-day practically all thinking men accept evolution as a fact, there is still no general agreement

as to the way in which it has been brought about. 'Though Darwin taught the world to believe in it, his 'natural selection' explanation of the origin of species is by no means universally accepted; for that matter no more is any other theory. The more one contemplates this condition of things the more clearly one sees that it is largely due to the fact that, even now, biologists in general will not realize, or will not remember, that in life the environment—function—organism triad is one inseparable whole. When the functional interplay between environment and organism ceases it is no longer life that is being considered. Among all the writers on evolution this ecological view-point of life—though they do not call it ecological—has been most distinctly emphasized by Thomson and Geddes (1918), but others, including Darwin himself, have approached very close to it.

Of all the ecological principles perhaps the first to be recognized is one that, according to Osborn (1925), goes back to Aristotle, though Aristotle did not think on evolutionary lines and, in his biology, applied his notions of development only to individuals. It is that change of motion, habit, or function precedes change of form. An example of the modern application of this principle may be quoted from McDougall's *Outline of Psychology* (it is one also quoted by MacBride, 1924):

'The seal did not take to the water because his legs were flipper-like, and his body fish-shaped, he acquired these peculiarities of structure in consequence of his food-seeking instinct having become specialized for the pursuit of fish. The evolution of the animal world may properly be conceived as primarily and essentially the differentiation of instinctive tendencies (that is, habits) from some primordial capacity to strive.'

Another associated principle, the so-called 'principle of compensation', also is said by Osborn to go back to Aristotle, but, in more recent times, it was more clearly formulated by Etienne Geoffroy St. Hilaire. It is that the increased motion or function of one organ is compensated for by the diminished motion or function of another organ (*loi de balancement des organes*).

It will be clear therefore that the older writers were fully alive to the importance of function. Buffon (1707-88) who

was the first to give a definite clear statement of the doctrine of evolution, thought that plants were moulded directly by the environment. Treviranus (1776–1837) laid stress on the influence of a changing environment in modifying living beings, but also on the power of the latter to adapt their organization to the environmental changes.

The latter idea is developed in Goethe's writings. He believed in an inherent 'growth force', an innate tendency towards fuller 'self-realization', but he agreed with Buffon that growth of form 'yields to change from externally acting causes'.

Erasmus Darwin (1731–1802), grandfather of Charles Darwin, was more definitely functional in his outlook. He believed in the inheritance of 'acquired characters' and was a Lamarckian before Lamarck, as his grandson pointed out.

Lamarck (1774–1829) provided in his *Philosophie Zoologique* 'the first connected and thoroughly logical exposition of the theory of descent', as Haeckel describes it. Lamarck's name has definitely become associated with the doctrine of the cumulative transmission of functional modifications, with the inheritance of characters acquired during the lifetime of the individual. 'Changes in environment bring about changes in the habits of animals. Changes in their wants necessarily bring about parallel changes in their habits. If new wants become constant or very lasting, they form new habits, the new habits involve the use of new parts or a different use of the old parts, which results finally in the production of new organs and the modification of old ones.' It is unnecessary to follow up at greater length the ideas of those pre-Darwinians, but it should be noted, as Thomson and Geddes point out, that 'some naturalists, such as Buffon, emphasized the importance of the environment; others, such as Lamarck, laid the main stress on function; others, such as Goethe, discerned that, after all, the moving spirit in the drama of evolution is the organism'. And the same authors go on to remark: 'It may be said without dogmatism that the adequacy of an evolution theory is in proportion to its recognition of all the three categories which give, in point of fact, the three aspects of life.' This is exactly the position adopted by modern ecology.

Darwin himself laid main stress on the variability of the organism and the process of natural selection through the survival of the fittest. The environment, by its sifting influence, was responsible for the 'adaptations' produced in the organism. Environment and organism were thus both important. Darwin, however, did not deny the possibility of functional modifications being inherited. Such a denial was left to the neo-Darwinians, who were influenced partly by the mechanistic explanations of bodily functions by the physiologists of the latter half of the nineteenth century, and partly by the theory of August Weismann who asserted that the germplasm is continuous, that all reproductive cells are produced directly by other reproductive cells and are not in any true sense the product of the complex organism which carries them, nourishes them, feeds them, and allows them to multiply. This is a theory which is intelligible and defensible as applied to animals, especially since Weismann admitted the possibility of a certain interaction between soma and germplasm, but it is much less easily applicable to plants, where, if germplasm exists, it must be diffused through every cell of the living plant. From a single epidermal cell, for instance, of a *Begonia* plant, it is possible to reproduce the whole plant, which will flower, produce sex cells or gametes, and form seed. As a matter of fact botanists, while often supporting the neo-Darwinian school on general grounds, have never been, on the whole, very enthusiastic about Weismann's 'germplasm' theory. While Darwin himself was prepared to take a holistic, ecological view of the evolutionary problem, the neo-Darwinians for the most part are not. They prefer to leave function alone. They concentrate on the organism and the mechanical, sifting, selecting influence of the environment.

The work of Gregor Mendel, published in 1865, if it was known to Darwin, which is uncertain, was not taken notice of by him, or by anybody else, until the beginning of the present century, when, more or less simultaneously it was re-discovered by De Vries, Correns, and Tschermak. Mendel investigated the problem of inheritance in plants, using mostly the common pea, which can be easily either self-fertilized or hybridized by crossing different varieties.



To enter into details, now generally familiar, would take up too much space, but, briefly, the result of Mendel's work was to show that inherited characters are dependent on unit factors derived from both parents, which maintain their identity throughout the life of the plant, and separate only when the sex cells (gametes) are formed. If the factors received from both parents are identical the individual is said to be homozygous, if different, heterozygous. Single characters are now known to depend on the interaction of more than one factor or 'gene', as the factors have been named by Johannsen. The genes, however, are viewed differently by different modern workers. Some, e.g. Castle, regard them much in the same way as Weismann regarded his 'determinants', as being living protoplasmic units which, in some unexplained way, are responsible for the definite characters. The genes themselves, being protoplasmic, admit of variability, though they remain for the most part unchanged. Others e.g. Hagedoorn, adopt a more definitely bio-mechanical viewpoint and regard the genes as definite non-living chemical substances, possessing autocatalytic properties, which are able to multiply but remain incapable of changing their chemical nature. Mendel's methods and principles were applied to animals by Bateson and others early in the present century, and, since 1912, an enormous amount of work has been done by Morgan and his associates on the fruit-fly, *Drosophila*. Similar work on plants has been carried on apace and the whole subject of genetics has now taken rank as a separate branch of biological science, largely as the result of the stimulus supplied by the re-discovery of Mendel's experimental work. This, however, has been assisted and amplified by work in other directions, and particularly by the remarkable advances in cytology and microscopic technique. The behaviour of chromosomes in the germ cells has been investigated in the minutest detail, and the processes correlated with such phenomena as the segregation of maternal and paternal components in the formation of the gametes, the association of transmissible characters in groups, corresponding to the number of chromosomes, sex-linked inheritance, and the breaking of linkages and 'crossing over' corresponding to the breaking across and rearrangement of two entangled

chromosomes, all of which tends to lend weighty support to the underlying hypotheses.

Whatever its influence on theories of evolution, there is no longer any doubt in the mind of any one that genetics, as a practical science of heredity, has a vast and increasing importance. Though hundreds of biologists are continuously engaged in genetical experiments, and the breeding of new varieties of plants and animals has already shown the great practical and economic importance of their work, yet they either, for the most part, still regard theories of evolution as speculative and relatively unimportant, or each defends his own particular view-point and refuses to countenance any other.

So far we have considered the two main views, that of Lamarck who is supported by those who believe that acquired characters, induced by the environment, can be inherited, and those of Darwin, as modified by Weismann and the neo-Darwinians, who favour the view that natural selection acting on small variations can gradually modify existing species and produce new ones.

A third and important school of thought is the Mutationist School, originated by De Vries but developed and modified considerably to fit in with the facts brought to light by the work of Mendel and the geneticists. A mutation is a discontinuous variation, a more or less wide saltation (or sport) which differs from the parent form in one or more well-marked characters. Darwin made many observations on such sports or mutations, but he objected to such 'sudden and considerable deviations of structure', as material for evolution, because he was of the opinion that they would be swamped by inter-crossing. The Mendelian discoveries have shown that this is not necessarily the case. A cell theory of mutations has been developed, e.g. by Gates (1915), based on cytological and breeding work with *Oenothera* and other forms. Mutations are found to depend on cell changes involving a new nuclear structure, e.g. the presence of an extra chromosome, multiplication of the chromosome numbers (diploidy, triploidy, tetraploidy, polyploidy), non-disjunction, &c. The great mass of mutations seem to originate as new Mendelian characters. De Vries assumed that all



mutations take place in the formation of the germ cells. The 'crossing-over', already referred to, takes place at this stage. Later work has gone to show that mutations may also take place at or after fertilization. Given the mutations, work on Mendelian lines shows that they may be shuffled and arranged in all kinds of combinations. Lotsy believed that all species formation is the result of crossing. To maintain this position it is necessary to deny variability within the species so that for Lotsy a species is what Johanssen calls a 'pure line,' i.e. it is genetically pure. This is not what constitutes a species in the Linnean sense.

Even though mutations can often be correlated with nuclear changes, this only carries us one step farther back. It does not explain how the nuclear changes themselves take place.

One view favoured by Bateson, Punnett, and other geneticists is that evolution in general has taken place by the loss of genes (i.e. apart from the effects of crossing). It is easy to see how a gene may be lost, but difficult to explain how an entirely new gene can be produced. Some think that possibly this may take place in lower unicellular forms, but emphasis is laid on the fact that (according to them) it is not definitely known to occur in higher plants or animals.

Yet even Weismann admitted that the germplasm might be modified by the environment under certain conditions, and the important work of Harrison (1920), on melanism and other racial characters in certain Geometrid moths, shows that, either one has to accept the Lamarckian position quite frankly, or adopt Weismann's modification of it and agree that a stimulus can be brought to bear (in this case feeding on food containing salts of manganese, &c.) sufficiently powerful to change the germplasm. One of the leaders of the neo-Lamarckian school is Professor E. W. MacBride. He remarks (1924) that most supporters of the evolutionary importance of mutations have only the phrases 'chance', 'accidents', or 'internal causes' to put forward to account for their appearance. The mutants obtained by Morgan in such numbers for *Drosophila* are, according to MacBride, practically all cripples and the vast majority are recessive to type. He does not think that they or any other similar mutants have played any part in evolution. Instead of the 'dropping

of a gene' hypothesis MacBride regards mutations as due to some pathological interference with growth, such as would be likely to occur under the methods of feeding of *Drosophila* adopted by Morgan. MacBride refers at length to the work of Tornier on gold fish, the domestic races of which are produced by the Chinese by keeping the fish under most insanitary conditions. 'In winter these are kept in earthenware pots ranged in hundreds on shelves in dark, ill-ventilated huts; in summer they are transferred to small, dirty, out-of-door tanks, which are over-grown with weeds.' According to Tornier all the numerous mutations in goldfish are due to 'the weakening effect on the vigour of the embryo of the abstraction of oxygen from the water during the first few days of its life'.

In addition to his work on Melanism, Harrison (1927) experimented on certain races of saw fly that fed on a particular species of willow. For some generations he compelled them to feed on another species. Later when they were given a choice of the original species and the one to which they had become accustomed, without exception they chose the latter, showing, it is claimed, that an acquired habit is inherited. Recently MacBride and Miss Sladden have carried out carefully controlled experiments with a Stick Insect (*Carausius*) causing it to feed on the ivy instead of the privet. The results show, according to MacBride (see *Nature*, 21 April 1934), that when members of one generation are compelled to adopt a new habit, a residual effect of this habit is carried over to the next generation. The opposite school has adversely criticized the work of Tornier, the work of Kammerer, Harrison, of all those who seek to show that acquired characters or habits can be inherited. Thus the dispute goes on.

At one time the Russian physiologist Pavlov indicated that what he called the 'conditioned reflexes' of animals, i.e. distinctly acquired characters, could be inherited, but, afterwards, apparently dissatisfied with the experimental conditions, withdrew the statement. When Pavlov's conclusions were first published, McDougall, who had already commenced similar experiments on rats, and had reached the ninth generation, decided to continue, and a few years ago (1927) claimed that the results he had obtained pointed

towards a positive conclusion concerning the validity of the Lamarckian principle and justified further experimentation.

The influence of internal secretions or hormones on heredity has lately received attention, and Cunningham (1921) has published a book on the subject. He draws a distinction between non-adaptive and adaptive characters, and regards the non-adaptive as due to spontaneous mutations, the adaptive as due to the direct influence of stimuli through hormones, causing somatic modifications which become hereditary, in other words to the inheritance of acquired characters. Among other things, he points out that it is the essence of Mendelism as of Weismannism that not only sex but all other congenital characters are determined in the fertilized ovum. This ignores the well-known effects, for instance, of castration, due to interference with the production of hormones. The influence of castration on secondary sexual characters, he maintains, is a phenomenon entirely beyond the scope of Mendelian principles. Again, the mutationists and Mendelians have not shown how the essential characteristics of mutations are to be reconciled with the facts of metamorphosis or with the recapitulation in development which is so often associated with metamorphosis. In fact 'all attempts to explain adaptation by gametogenic mutations or changes in gametic factors or genes have completely failed as Bateson himself has admitted'.

'Secondary sexual characters, usually in the male sex, correspond in their development with the development of maturity and functional activity in the gonads, and it has been proved that the latter influence the former by means of hormones or internal secretions. The evidence concerning sex, and sex-linked characters and the localization of their factors in the chromosomes of the gametes has no bearing on the action of the hormones.'

'It was formerly stated that no process was known or could be conceived by which modifications produced in the soma by external stimuli could affect the determinants in the gametes in such a way that modifications would be inherited. The knowledge now obtained concerning the nature and action of hormones shows that such a process actually exists and in modern theory real substances of the nature of special chemical compounds (the hormones) take the place of the imaginary gemmules of Darwin's pangenesis or the "constitutional units" of Spencer.'

Apart from the sex hormones, other hormones have also received much attention from physiologists in recent years. The pituitary gland, for instance, is very important in secreting hormones which regulate growth. In the disorder known as cretinism there is functional derangement of the thyroid gland, which leads to morphological changes, e.g. the flat undergrown nose of the Negro or Mongolian type. Acromegaly, according to Sir Arthur Keith (1931), revealed one of the growth mechanisms of the human body, and he has come to the conclusion that the cranial and facial features of primitive man and those of acromegalic men and women are of the same nature—only in primitive man they were produced normally, in the acromegalic abnormally. From such observations it would appear that, valuable as are the results obtained by correlating chromosome behaviour and inheritance, equally valuable results may be looked for by studying the relationships between growth and heredity and the functional activity of internal glands and the hormones produced by them. Whether these in turn are to be correlated with chromosome behaviour or not, at least they form an important link in the chain which cannot be neglected.

The modern functional outlook is well illustrated by the work of Child on the physiological foundations of behaviour (1924) and his theory of 'physiological gradients'. The physiological gradient consists of a graded difference in physiological activity including velocities of chemical and physical reactions, colloidal dispersal and ionization, in different parts of the organism. The environmental energies set up such physiological gradients and the structure and function of lower organisms are thus determined. By controlling the gradients it is possible to develop organisms with small heads, dwarfed brains, or with the eye of a Cyclops in the median plane. Other structures and functions can be changed in a great variety of ways, polarity and symmetry may be obliterated, in short 'by controlling the physical and chemical environment of the average individual it is possible to alter the whole pattern to such an extent that the resulting individuals differ far more from the normal than even widely separated species do from each other; moreover, these alterations are not random occurrences but can be predicted to a



high degree'. Child thinks that 'the hereditary constitution of each protoplasm reacting to the external differential gives first the physiological gradient and then, on the basis of this, development and differentiation'. As May in a descriptive article puts it (see Murchison, 1929): 'Heredity supplies the potentialities of excitation and reaction; it also determines the degree of persistence or effectiveness of the gradient. Environment, on the other hand, determines which gradient shall operate and how they shall operate.' Among higher organisms Child admits that the gradients are harder to control and the hereditary patterns more set. He has, however, brought forward evidence to show that among higher organisms the structure and functions of the nervous system originated in excitation-transmission gradients.

Such modern work on physiology, when applied to the question of inheritance inevitably tends to lead back to an older view-point, the so-called mnemic theory. It may be true that when the physiologist and psychologist can reach a satisfactory explanation of memory, the question of heredity will at the same time be solved. Heredity was regarded by Samuel Butler as nothing more or less than a name for 'Organic memory' or 'Race memory'. Butler, in his own whimsical way, was inclined to father his physiological theory on to Hering who had expressed the same idea in a more morphological manner. Haeckel too was one of its advocates, but its more recent and more clarified expounding is due to Semon. When living matter has been stimulated it is not the same after it has received the stimulus as before. Even a bar of iron is not the same after it has been once struck. The residual effect of a stimulus was called by Semon an 'engram' and the sum of an organism's engrams is its 'Mneme'. Sometimes an engram may be recognized only functionally. Sir Francis Darwin, who expressed himself in favour of the mnemic theory in his address as President of the British Association in 1908, illustrates this by his experiments on rhythmic reaction to periodic stimuli, which are continued after the stimuli are removed. Only when engrams are added to the nucleus of a germ cell, as the result of prolonged action, according to Semon, can they result in new characters which are inheritable. This is naturally a



slow process, and it is not surprising that experiments carried out during a limited period of time to demonstrate the inheritance of such acquired characters, should, as a rule, show negative results.

The mnemic theory has appealed not only to plant physiologists, such as Sir Francis Darwin, but to leading botanical morphologists as well. Thus Bower in his article on Botany in the collective work entitled *Evolution in the Light of Modern Knowledge* (1925) says:

‘The prevalence of adaptation and its frequent homoplastic origin, together with the arguments of comparative morphology, checked and supported by palaeontology, clearly point to the propriety of a position of suspended judgement as to the non-inheritance of acquired characters. The facts derived from Ferns certainly suggest the acceptance of some form of mnemic theory as a working hypothesis for plants, until a final decision be obtained. Moreover, this attitude to the problem seems more likely to produce that decision than the passive acceptance of a rigid negative.’

This open-minded attitude appeals equally strongly to the ecologist and to all who endeavour to view the problem of inheritance and evolution as a whole.

#### HUMAN HEREDITY AND ECOLOGY

At present we are primarily concerned with man and his ecological behaviour, and it is now necessary to inquire how the study of heredity and evolution among plants and animals throws light on our general problem of human ecology.

First of all as regards the physical basis of inheritance, each individual starts life from a single fertilized ovum or egg cell, to which each parent contributes one half of the hereditary genes. The genes remain arranged in pairs, one member of each pair being paternal, the other maternal. Each pair is concerned in the development of the same character, e.g. eye colour, but the two members may not act in the same way, one may produce one colour, the other a different colour. In such a case the result is not a blend of the two colours. One gene is said to be dominant for that character, the other recessive, and the result produced in the

offspring is the effect of the dominant gene by itself. The recessive gene, though present, has no apparent effect. Where blending does occur it is regarded as the action of more than one pair of genes. The doubling of the genes, is, to quote Jennings (1930), 'the biological ground for our having two parents instead of one. Gene defects are so common that without this doubling, the two genes of each pair coming each from a different source, defective individuals would be far commoner than they are.' Defective genes are, as a rule recessive, though a few are known to be dominant. It is well to remember that an apparently normal individual may, in fact usually does, carry a number of defective genes for one character or another. A parent may hand on to his offspring defective genes which had no effect on himself and were not recognizable because they were recessive. If such a defective gene meets and pairs with another similarly defective gene from the other parent the offspring in this case shows the corresponding defective character, since both members of the pair are defective. Since such characters as feeble-mindedness have been shown to behave according to these Mendelian principles, the importance of such genetical analyses is at once obvious.

On the other hand parents who are both defective may, on occasion, produce normal offspring if the defects of the two parents are due to genes belonging to diverse pairs. So long as the children of defective parents obtain one normal gene for each pair they will be normal and therefore superior to either of their parents, though they will, of course, continue to carry the defective genes as recessives. It is only when the defects of both parents lie in the same gene pair that the offspring of such must also be defective. The less closely related the parents are the more likely are defects they possess to lie in diverse pairs of genes. This is a biological argument against the marriage of closely related people and in favour of outbreeding, an argument that gains in force according to the degree of possible defectiveness of genes in the parents. It is well, however, to examine in greater detail what the exact effects of inbreeding are.

East and Jones (1919) state that 'inbreeding has but one demonstrable effect on organisms subjected to its action—

the isolation of homozygous types. The diversity of the resulting types depends directly upon the number of heterozygous hereditary factors present in the individuals with which the process is begun; it is likely, therefore, to vary directly with the amount of crossbreeding experienced by their immediate ancestors. The rapidity of the isolation of homozygous types is a function of the intensity of the inbreeding.' In other words, inbreeding leads to racial or genetic purity. Races become uniform by inbreeding. Now whether this is desirable or not depends entirely on the inheritance received. If undesirable characters are present they will be shown by inbreeding, if they are not they cannot thus be created. Moreover, through the action of natural selection, undesirable or inferior types tend ultimately to be eliminated and sound types preserved, so that inbreeding ultimately may lead to the production of sound good types which are genetically pure and continue to breed true, or in other words good stable types.

However, even if inbreeding shows no positively harmful results, the crossing of such pure bred types often leads to the offspring of the cross showing a remarkable improvement in vigour, the so-called phenomenon of hybrid vigour. This is particularly striking in the case of many plants and animals. The hybrids in such cases have been shown not only to grow more vigorously but to be hardier and more resistant to disease. When germinal heterogeneity is at its maximum, vigour is greatest, when the heterogeneity is reduced by inbreeding vigour is lost. The explanatory hypotheses put forward are, first of all, that hybrid vigour is due to the stimulation of crossing and the interaction of *different* hereditary factors, and, secondly, owing to the complementary action of dominant factors (East and Jones, loc. cit., pp. 168-86), but it is enough, for our present purpose, to note the facts without entering too fully into possible explanations.

The phenomenon of hybrid vigour among plants and animals, though common, is not, however, universal. Sometimes it is combined with increased fertility, sometimes with lessened fertility or even complete sterility, or species hybrids sometimes show decline in vigour combined with sterility. These differences seem to depend on the nature of the cross.

When the differences in the germplasms are too great, crossing leads first to all to a loss of fertility (as in mules) and then to a decrease of vigour as well.

As far as man is concerned, East and Jones point out that there are two different kinds of racial crossing, the one a wide one as between black and white 'the real result of which is to break apart those compatible physical and mental qualities which have established a smoothly operating whole in each race by hundreds of generations of natural selection', and the other between races which show few differences. East and Jones decide against the desirability of crossing between races that are too wide apart, but they are most emphatically in favour of crossing of the second type.

'The foundation stocks of races which have impressed civilization most deeply have been produced by intermingling peoples who through one cause or another became genetically *somewhat* unlike.'

'Whatever the causes of racial separation under the isolation characteristic of former times, peoples did come to have a rather narrow variability. They were, one might say, homozygous for certain traits. These traits naturally differed in their value. There were great peoples, mediocre peoples and wretched peoples. But each was more or less standardized. When there came occasion for these standardized peoples, differing in their transmissible characters, to intermingle, great variability was produced; and if the differences were not too great, the chances were high that valuable character combinations would come to light.'

In support of their genetical hypothesis they quote many interesting facts from ethnological history of which only one or two need be mentioned here.

'Is it not a fair assumption', they ask, 'that the backwardness of Spain and Ireland is due to their relative isolation?'

'Is it not because the waves of migration were nearly spent before they reached these land's ends?'

'Contrast the people of the United Kingdom, more particularly the natives of the South and West of Ireland, with those of Scotland and England. In proportion to their numbers no modern people has approached the English and Scotch in number of illustrious men or in height of creative ability, except the French; the true Irish have hardly a single individual meriting a rank among the great names of history, or a contribution to literature, art or science of first magnitude.'



Similarly they deal with the Jews.

‘They should not be overlooked in this connexion, because of the mistaken idea that they form a pure race of narrow variability characterised by fixed traits. Nothing is further from the truth. The very term race applied to the Jew is a misnomer.’

‘They arose from complex crosses, the Arabs, the Assyrioides or Hittites, and the Aryan Amorites. Later moving into every part of Europe, they mixed with the people with whom they sojourned to a very considerable extent, though keeping up the while the religious ideal of racial purity.’

To summarize, according to East and Jones:

‘There must be racial mixture to induce variability, but these racial crosses must not be too wide else the chances are too few and the time required is too great for the proper recombinations making for inherent capacity to occur. Further, there must be periods of more or less inbreeding following racial mixtures, if there is to be any high probability of isolating desirable extremes. A third essential in the production of racial stamina is that the ingredients of the Melting Pot be sound at the beginning, for one does not improve the amalgam by putting in dross.’

The extreme practical importance of the genetical method of approach has been sufficiently emphasized by the work of East and Jones and other writers on similar lines. Unfortunately there are others, who, in their enthusiasm for this line of attack, are apt to push things too far and assume that man is as he is and behaves as he does entirely because of the genes he happens to possess. Certainly there are many characters in man that the environment cannot, or at least cannot easily, alter, e.g. sex and sex-linked characters such as haemophilia (or bleeding), eye colour, &c. It may be granted also that many differences in mentality do depend on differences in genes or hereditary endowment. But the individual shows enormous powers of adjustment to diverse environmental conditions, and the claims of Watson and the behaviourist school of psychologists that any *normal* individual can be turned into any type you please, by appropriate conditioning, is not so very far fetched, provided the individual is normal, i.e. possesses the necessary genes to make adjustment possible.

In one of the most thoughtful chapters of his work already referred to, Jennings (1930) deals with a number of biologi-



cal fallacies in connexion with human affairs. Among others he refers to one that underlies most of the special fallacies seen in genetic biology, one that Morley in his life of Gladstone asserts to be the greatest affliction of politicians; it is the fallacy of attributing to one cause what is due to many causes.

‘This fallacy is the commonest error of science, making unsound a considerable portion of its conclusions. Everywhere there is search for *the* cause of this or that phenomenon; the investigator is not content until he has found *it*. Yet natural phenomena—and most emphatically is this true of biological phenomena—merely arise out of the complex situation in which they occur. Many elements of that situation affect them; and all that experimental science can do is to determine what difference is made by altering one or more of these elements; none is *the* cause to the exclusion of the others.’

If space permitted, a summary of Jennings’s views, regarding other and more special fallacies, would be well worth while. His own view-point is to a considerable extent holistic and ecological. In fact, he says:

‘It appears indeed probable, from the present state of knowledge and the trend of discovery, that the following sweeping statements will ultimately turn out to be justified. (1) All characteristics of organisms may be altered by changing the genes. (2) All characteristics may be altered by changing the environmental conditions under which the organism develops; provided we learn what conditions to change and how to change them. (3) Any kind of change of characteristics that can be induced by altering genes, can likewise be induced (if we know how) by altering environmental conditions. (This statement is open to more doubt than the other two; but it is likely eventually to be found correct.)’

What Jennings is not, however, prepared to admit is that acquired characters, the result of environmental influence, can be inherited.

‘It is commonly held that the inheritance of acquired characteristics has as yet not been demonstrated to occur in organisms above the Protozoa. And the conviction is growing that this is because such inheritance indeed does not occur and hence will never be demonstrated in higher organisms. Direct action of certain agents on genes, resulting in gene mutations, that are usually injurious, has been demonstrated.

But the supposed tendency of the germ cells to reproduce habits and other characteristics acquired under special conditions by the parent is a very different case.'

It is hardly necessary to pursue the unending discussion regarding the inheritance or non-inheritance of acquired characters any farther. From what has been said it will be apparent that biologists fall into three divisions as regards their view-points in this matter. Some have made up their minds definitely that acquired characters cannot be inherited. They are so very positive and are inclined to be so vigorous in their destructive criticism of all attempts to prove the contrary, that they have been able to exercise a very powerful influence not only on scientific but also on popular opinion. Others, such as those who favour the acceptance of some form of mnemic theory, are more open-minded on the subject. They admit that they do not feel very clear about how exactly such inheritance may take place, but they feel that it may occur and if it does, it affords a far more satisfactory explanation of the facts of adaptation, and the facts brought to light by palaeontology and the study of comparative morphology, than any other explanation. A third school are definitely of the opinion that some acquired characters, habits at least, have been shown to be inherited.

The environment acts in different ways. First of all it has a direct effect on the organism, in respect to the part it plays in maintaining life. As we have already sufficiently insisted, the environment is an integral part of the life process. A change of the environment involves a change in the life process, and this often leads to structural changes as well. In the second place, changes in the environment may bring about changes in the germplasm usually of a harmful nature, and thus alter the course of heredity. All biologists are more or less prepared to accept this conclusion. Mutations, for instance, have been brought about by exposure to radioactive substances and Harrison's work on melanism, already mentioned, is another example. The effects of alcohol on the germplasm and heredity have been much studied from this standpoint but without any very positive results. Thirdly, the environment exercises a very powerful selective action on organisms in general, by eliminating those unsuited to it.

This is the type of action emphasized by Darwin and since then generally accepted. Since the environment eliminates the unfit, it would seem to follow that the harsher the environment, the more difficult conditions are, the 'fitter' and more vigorous the organism will become. There is, however, a very obvious limit to this process. At a certain stage the environment becomes so unfavourable that the life of the organism is impossible and total elimination results. Before that stage is reached the environment tends to dominate the biological triad which constitutes life to such an extent that the part played by the organism (especially in the case of man) is entirely subordinated to the environment. Passive qualities of stoical resistance are developed and the more active qualities, by which man in turn exercises a modifying influence on the environment, are held in abeyance. The whole comparative study of man's cultural development shows that this state of affairs is not desirable. Man, throughout his history, has consistently endeavoured to, and largely succeeded in, improving his environment.

Improvement of the environment, as far as natural selection is concerned, has, of course, the opposite effect from increasing its harshness. It enables types to survive that are not so vigorous, that possess weaknesses of one kind or another, that are defective. Impressed by this fact many people have said that the inevitable effect of progress in civilization is to lead to race degeneration, and there is no doubt that at least it leads to changes.

Mankind here seems to be faced with a dilemma. On the one hand, a harsh rigorous environment may so dominate man that he can only passively submit to it and not seek to control it, thus partially or almost wholly sacrificing an urge which is part of his inheritance as a species, the urge to control. On the other hand, when the environment becomes too easy, too favourable, the process of natural selection is interfered with and the less vigorous types are able to survive equally with the more vigorous.

It is obvious that the whole position wants very careful consideration, more careful consideration than has been given to it by those who have urged that many characteristic features of our civilization are positively harmful, though

directed towards what are generally regarded as beneficial ends, e.g. organization for furthering public health, sanitation, hygiene, general social welfare, &c., in a word, all that tends to preserve the lives of weaklings. One thing is certain. Man is never likely to abandon deliberately his efforts to control his environment, to control nature. That has been one of his main distinguishing characteristics ever since he became man, and it may be pointed out that he has shown progress, even racial progress apart from increased culture, in spite of it. Moreover, as he changes his environment, he changes also its selective action. The types that survive will presumably be such as are adapted to the changed or new environment and not to the old. Though a modern inhabitant of one of our large cities may not have the characteristics which enable the Eskimo to survive in the frozen North, yet, on the other hand, the Eskimo is not naturally particularly well adapted for survival in the city.

No one is likely to deny that modern civilization is by no means as yet perfect, and further, that man in his cultural progress has more than once taken directions which have proved harmful to himself. Yet this is no argument for going back to the conditions which prevailed before civilization commenced. It is only natural that as man, by his powers of control, changes his environment he himself changes with it.

#### EUGENICS

The pioneer work of Galton, who founded 'Eugenics', has been carried on by his pupil and successor, Karl Pearson, who, with his associates has amassed an immense amount of information regarding heredity in man from the statistical or biometric standpoint. Many workers on genetics also, impressed by the results obtained in the efforts to improve races of domestic plants and animals, have joined in the movement designed to improve human stocks by similar methods. This is what Eugenics stands for: the use of modern scientific methods to secure the production of better breeds of men. Its supporters claim that it 'is incomparably the greatest concern of mankind'.

It may be added that it is also one of the most difficult, and, so far, mankind as a whole has apparently not been very



largely impressed by the efforts made on its behalf. Perhaps this is largely due to the fact that eugenics has tended to adopt a rather narrow view-point. For one thing, its most strenuous supporters have been extremely vocal in proclaiming that, since acquired characters cannot be inherited, improvement of the general conditions of life is so much wasted effort; the only way to improve the race is to get rid of its defective genes as completely as possible. If the public conscience cannot permit of the carriers of such genes being destroyed, they can at least be prevented from having children, and so perpetuating their defects.

The main difficulty that arises in connexion with this proposal is not so much the difficulty of rousing public interest and changing established customs (though that is serious enough), but the fact that the carriers of defective genes, provided the genes are recessive, as they usually are, cannot by any process known to biological science be, with certainty, recognized. If, in a single pair, both genes are defective then they produce a defective character, but if only one is defective the bearer is normal. Thus, according to Jennings, statistics have shown that, in a population of one hundred millions there are about 330,000 feeble-minded. Those have each two defective genes producing this feeble-minded condition. But for every such individual, it is computed, there are 30 normal individuals, each bearing one such defective gene, so that in the same population there are 10 million who, if they intermarry, are likely to produce feeble-minded children. The 330,000 could be got rid of in the course of a single generation, but the 10 million would remain, and from these in the next generation, it is calculated approximately 293,700 new feeble-minded would be produced. In the third generation, even if the feeble-minded themselves were not allowed to marry, another 290,000 would be produced by the mating of the apparently normal, and after that very little progress would be made. As a matter of fact the vast majority of feeble-minded individuals are produced by the apparently normal who are the bearers of defective genes.

Defective genes, which are recessive, and produce no effect on the bearer, can hardly be eliminated, but our modern knowledge of genetics does at least permit of eugenic methods



being adopted which will, as far as possible, nullify their immediate effects. If, in any two families, defects are known to occur, members of these families, even though both may be normal, should not intermarry since the chances are that each carries defective genes. Close relatives should also avoid marrying unless it is very certain that there are no defective genes present in the family. But at best such measures only serve to keep the defective genes concealed; they cannot get rid of them.

From the ecological view-point it is interesting to note the effects of such customs as exogamy and endogamy on racial progress. The effects of inbreeding have already been explained. They are not necessarily harmful since they bring to light hidden defects which may then become eliminated and under primitive conditions of social development naturally would be. Inbreeding also leads to the establishing of racial purity. East and Jones's remarks regarding the advantages of racial crossing (provided the races are not too widely separated), followed by inbreeding, need not be repeated, but the ecologist and historian will find it a very interesting task to follow out in more detail than has yet been attempted the working of the principle in the history of races. It is unlikely that man in his many diverse customs has always acted in the best way from the eugenic standpoint. It would be very difficult, for instance, to justify much of the complexity of the marriage laws among primitive peoples or, to come nearer home, the law that used to forbid a man from marrying his deceased wife's sister.

Ecology must always draw on all the branches of biological science and none is probably of more importance to ecology than the comparatively new science of genetics and the study of man's heredity in general.

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## IV

### RESPONSE TO THE ENVIRONMENT

Introductory—Response to Individual Environmental Factors—Response to Climate as a Whole—Maladjustment to the Environment—Man's Diseases—Bibliography.

#### INTRODUCTORY

**I**N the present chapter we shall commence the study of the middle term of the triad and at first confine ourselves, more or less, to man's physiological responses to his environment. This is the aspect of human ecology which permits most readily of definite experimental treatment and, for that reason, is likely to show a continuance of the progress that has already taken place, progress that has been largely due to workers on applied physiology attached to different schools of medical research. To summarize all the important results already obtained is a very difficult and, in one short chapter, a quite impossible task. At most a few interesting facts can be selected to illustrate the methods of research adopted. The works of J. S. Haldane, Sir Leonard Hill, and his associates at the National Institute of Medical Research, and Ellsworth Huntingdon are all full of ecological interest and have been freely drawn upon. As pointed out in the first chapter the methods and technique of plant and animal ecology are useful and suggestive in the study of human ecology, though only up to a point, since man and his environment are unique. Man's responses to different environmental factors may first be considered, though it is impossible in nature to isolate each factor and consider its effect without reference to the others. Afterwards man's response to climate as a whole and a few well-known examples of ecological maladjustments will be dealt with, leaving his psychological reactions till later.

#### RESPONSE TO INDIVIDUAL ENVIRONMENTAL FACTORS

1. *Temperature.* The range of temperatures to which man can adjust himself depends on other factors, particularly the amount of moisture present and movement of the air.

Experiments by Blagden and Fordyce are referred to by Hill (1925). They were only able to remain for 15 minutes in a damp room heated to  $129.9^{\circ}$  F. ( $54.4^{\circ}$  C.), and the body temperature in that time rose to  $100^{\circ}$  F. On the other hand, they were able to withstand similar exposure in a dry room with the temperature well above the boiling-point of water,  $239.9^{\circ}$ – $260^{\circ}$  F. ( $115.5^{\circ}$ – $126.7^{\circ}$  C.), while the body temperature remained normal. The latter temperatures, according to Haldane and Huxley (1927), are sufficient to cook a steak in 5 minutes. Hill, however, remarks that if the occupation of such an oven were to continue, the sweating mechanism would eventually fail and heat stroke result.

Under high temperatures movements of the air carry away heated saturated air from the surface of the body and prevent heat stroke. Experiments made with the kata-thermometer (an alcohol thermometer designed to measure the rate of cooling by timing the fall of the spirit by means of a stop watch or more elaborately by electrical or self recording devices), in India, by Captain Petit (quoted by Hill, loc. cit., p. 89), showed that the thermometer cooled from  $100^{\circ}$  to  $90^{\circ}$  F. in 22 minutes 5 seconds, if the doors and windows of his room were shut, while under a punkah it cooled in 6 minutes 9 seconds. Hill mentions the fact that the victims of the Black Hole of Calcutta died from heat stroke not from suffocation. Heat stagnation and not chemical poisoning is the cause of oppression in badly ventilated rooms, as was shown many years ago by Hermann and confirmed by recent experiments carried out by Hill. Observations and experiments on the process of sweating, which, of course, results in the loss of heat by the body to supply the energy necessary to evaporate moisture from the skin, give interesting results. Haldane and Huxley (1927) inform us that men can sweat one litre of water per hour, and the world's sweating record is held by an English coal miner, who lost 18 lb. (1.8 gallons or 8 litres) in  $5\frac{1}{2}$  hours. The evaporation of one litre of water at the body temperature of  $98.4^{\circ}$  F. requires 570 kilocalories. To make up for the loss of sweat one must drink more water and eat more sodium chloride than usual. If the salt is not replaced and much water is drunk 'water poisoning' may result leading to muscular cramps. Haldane and



Huxley mention that miners, working in great heat, are fonder than the average man of bacon, kippers, and salt. Salt, too, is a more definite necessity to the inhabitants of hot countries than to dwellers in colder regions and is more highly valued. Too high a temperature increases metabolism. As the temperature of the blood rises the heart beat is quickened and respiration is affected. No one can survive a body temperature of more than  $113^{\circ}$  F. for very long.

Man can also withstand extreme cold, by conserving his body heat through wearing warm clothing, or by increasing the production of more body heat through taking exercise. Conduction of heat is important and dry cold air is more bearable than moist cold air. The effect of too extreme cold is to lessen metabolism. Less heat is generated and less energy is used up. Death from cold appears to be due mainly to asphyxia. The optimum temperature for man naturally varies somewhat according to race and origin. For the white man, according to Ellsworth Huntingdon's experiments, carried out in the United States, the optimum is rather higher than one would expect. Different classes of factory workers were found to be physically most active when the average temperature was from 60 to 65 degrees, that is, when the room temperature rose to 70 degrees or even more. The mental activity of the students at West Point and Annapolis, on the other hand, reached a maximum when the outside temperature was  $38^{\circ}$  F., though the curve remained fairly flat up to  $54^{\circ}$  and only began to fall steeply at  $75^{\circ}$ .

2. *Light and Radiation.* The amount and quality of the sun-energy which reaches the earth's surface varies with altitude, latitude, and condition of the earth's atmosphere (cloudiness, humidity, &c.). On clear days about 75 per cent. of the total energy arrives at 1,800 m. altitude, but only 50 per cent. at sea-level. Mountain sun is richer in ultra-violet rays, more luminous, and has greater heating power. While the infra-red (or heat) rays heat the surface of the skin, the visible light rays penetrate more deeply and heat the blood and tissues. The actinic rays at the blue end of the spectrum and the ultra-violet rays possess great chemical powers. In recent years the ultra-violet rays have been much studied in relation to health. These rays, according to Hill (1928) dis-



place electrons in the atoms of certain substances in the living cells and so induce molecular changes, ultimately causing the death of the surface cells, which are replaced by new ones. The local reactions in the skin provoke secondary reactions in the blood and body generally. Ergosterol, a substance which is present in foods and in the skin, is activated by ultra-violet rays and becomes vitamin D, which is required for bone formation. It is interesting to note that the want of this vitamin causes rickets.

The ultra-violet rays cause 'sunburn' and the formation of a brown pigment, melanin (natural to the negro), in the skin. Melanin absorbs the light rays, except the red end of the spectrum, and the energy converted into heat increases the evaporation from the skin. Negroes are able to sweat more easily than white men. Ultra-violet light has the power of killing microbes, and 'light baths' are useful for the treatment not only of rickets but also of tuberculosis of the skin, glands, and joints, many skin and eye diseases, and other diseases as well.

While the effects of relatively short periods of exposure to strong light are considered beneficial, prolonged exposure may be injurious; in fact, it has been suggested that the backwardness of tropical countries is due to excessive sunlight. Since it is impossible to separate light from other factors this is very difficult to prove, but even where ultra-violet light is artificially produced by the mercury vapour lamp, care has to be exercised to avoid over-exposure to its (generally beneficial) action.

3. *Humidity.* In plant ecology much use has been made of the atmometer, an instrument consisting essentially of a porous clay cup, with a measuring tube attached, which measures the evaporating power of the air over longer or shorter intervals. This instrument has also been used in studies on human ecology, e.g. by the New York State Commission on ventilation. In dry weather metabolism is more active. The body loses more water by evaporation and the cooling effect of this leads to a necessity for a balancing production of more heat and therefore oxidation is increased. When the air is relatively drier more carbon dioxide is exhaled.

As already pointed out, it is very difficult to separate the two factors, humidity and temperature. Great humidity

combined with heat is distinctly harmful and causes low general efficiency and, if the temperature is raised still farther, soon proves fatal. Cold wintry air may have a very low relative humidity but cold damp air causes the body to lose heat very rapidly, and become less resistant to disease-causing organisms. A damp, wet climate also leads to an increase of the diseases classed under the general name of rheumatism.

It must not be assumed, however, that the relative humidity cannot be too low. In some of the extreme desert regions of the world the air is so dry that it is impossible to keep on drinking sufficient water to replace the water lost from the body by evaporation. In America, where the air inside buildings is often kept very dry during winter, its harmful effects, according to Huntingdon, have long been appreciated by physicians, students of factory management, school superintendents, and many other people. The discomfort caused by gas fires and their drying effects on the air are well known.

4. *Atmospheric Pressure and Winds.* The work of Lehmann and Pedersen, published under the title *Das Wetter und unsere Arbeit*, is quoted by Ellsworth Huntingdon (1915). These workers in Denmark and Norway made a series of daily tests of strength of three individuals by means of a dynamometer. They found that a lessening of atmospheric pressure, due to ascending from 2,000 to 3,000 feet, makes little difference, but an increase of pressure, made by descending a similar distance, leads to a marked increase of strength which disappears within three or four days. The explanation offered is that the red blood-corpuscles multiply rapidly under reduced pressure, but are slower at disappearing once pressure is again increased. Thus, for a time after one descends to lower altitudes, owing to the persistence of the more abundant red corpuscles, more than the normal amount of oxygen is absorbed and more than the normal strength is shown. Huntingdon, suggests that this may explain why mountaineers are irresistible when they descend upon the plains in sudden raids. It may explain also, in horse racing, why horses brought down from higher altitudes are supposed to win more easily.

J. S. Haldane (1931) gives other details regarding the

process of acclimatization to high altitudes. Mountain sickness, often experienced when going rapidly from about sea-level to an altitude of over 10,000 feet and staying there for a few hours, is due primarily to defective saturation of the arterial blood with oxygen. Acclimatization to low oxygen pressure is brought about in different ways. First of all (as already mentioned) the blood becomes richer in haemoglobin. This tends to keep the oxygen pressure higher, not in the arterial blood itself but in the tissues, which is the essential matter. The percentage of haemoglobin in the blood also varies inversely with oxygen pressure when that is increased above the normal, a fact which, as Haldane remarks, illustrates very clearly the connexion between function and structure. The bone marrow, where the red corpuscles of the blood are produced, becomes altered in structure at a high altitude, just as the blood itself is altered in structure.

The second factor in acclimatization, according to Haldane, is a marked increase in breathing, without this being due directly to want of oxygen as a stimulus. At first the breathing is directly stimulated to an appreciable extent by want of oxygen. But the resulting excessive removal of carbon dioxide makes the blood and tissues alkaline. To this condition the kidneys respond by removing gradually what is now excess of alkali from the body, with the result that a lower pressure of carbon dioxide in the lung air, and correspondingly increased lung ventilation is made possible without the blood being too alkaline and the circulation being correspondingly diminished; and the consequent increased pressure of oxygen in the lungs helps to counteract the diminished saturation of the haemoglobin with oxygen.

The third factor is that, as a result of a stimulus originating in the lowered oxygen pressure in the tissues, the living walls of the lung capillaries begin actively to secrete oxygen into the blood and gradually become more efficient in doing so, just as other activities become more efficient with practice. They help in this way to increase the saturation of the arterial blood. This active secretion of oxygen is analogous to the active secretion which occurs in various glands. Still another factor in acclimatization appears to come into play after long exposure to low atmospheric pressure. It appears that

the tissues of the brain and other parts become in some way tolerant towards the unusually low pressure of oxygen in the arterial blood. Hence natives or long residents at a high altitude show marked blueness of the skin, and a correspondingly low arterial oxygen pressure, though they remain in good health.

Haldane has been quoted at considerable length, for nothing could illustrate better than all the details he gives the close inter-dependence of organisms and environment. As he himself says, to quote still further,

‘Bernard regarded the blood as an internal environment, bathing all the living cells of the body. In reality, however, the environment of each cell depends on the influence of other cells, so that, properly speaking, there is no common internal environment, but only a common element in environment. Thus the blood bears to actual cell environment a similar relation to what the external environment does, but of a much closer and more definite sort.’

‘The life of an organism is ultimately just as much bound up with its external as with its internal environment; without, for instance, a continuous supply of oxygen and food material life could not continue. But just as with the internal environment, we can no more regard the activity of the organism as a determining cause of the external environment than the external environment as a determining cause of the organisms’s activity.’

‘Life is Nature expressing herself as a characteristic whole which has no spatial bounds.’

The effect of winds, especially the rain-bearing winds, is, to a large extent, bound up with the general climate. Yet, apart from this, high winds undoubtedly cause physiological and psychological effects which are somewhat difficult to determine accurately. Hot, dry winds of the Foehn type blow at certain seasons of the year in various mountain regions. They are familiar to residents of Natal. The air, as it descends from higher levels to lower, becomes heated rapidly and the temperature rises to over 100° F. in the shade. Some people, among whom the writer counts himself, find such winds stimulating, at least for a time, and Foehn winds do not blow for more than two or three days at a time. Other people, perhaps the majority, find them trying. The stimulation is there but it causes a feeling of nervous irritation.



Again, however, it is difficult to separate the effects of wind and temperature.

Huntingdon describes the effect of the prolonged wind in the basin of the Seistan in Persia, which, during the summer, from June to September, blows violently from the north and is known as 'The Wind of One Hundred and 'Twenty Days'. Europeans find this wind very trying, making them lazy and irritable. The natives, too, of this region are more inert and inefficient than elsewhere in Persia. The Sirocco of North Africa and the Mediterranean region, which goes under other names as well, has similar but less pronounced effects. Huntingdon concludes that occasional short-lived gales and frequent light or moderate winds are beneficial, while long periods either of steady calms or of gales are depressing.

5. *Food*. In many ways this is the most important factor in human ecology. Man, like other animals, requires food to supply the necessary energy for work, for the metabolic processes that go on in his body, for growth, and to replace wear and tear. The body temperature must be maintained and the heat lost by his body made up for by the heat value of the food consumed. The amount of energy units required varies with the amount of work done and with the body weight, from about 2,500 Calories for a man of average weight leading a sedentary life up to about 4,000 Calories for one doing heavy work. The food substances consumed include carbohydrates, fats, proteins, mineral salts, vitamins, and water. The first three are the sources of energy. Measured in terms of heat, 1 gram of protein or 1 gram of carbohydrate each produces 4.1 Calories of heat while 1 gram of fat produces 9.3 Calories. Protein, however, has a further stimulating action resulting in the release of more heat energy from the body provided it is well nourished. Both protein and fats are less necessary in hot countries than in cold. Carbohydrate is the best food for muscular work, but in very cold countries sufficient carbohydrate, even if available, could not be digested to keep up the body temperature, and fats and proteins, therefore, form the main sources of food. The quality as well as the quantity of the food supply must be sufficient. The disease pellagra, for instance, is associated with the deficiency of food in certain amino-acids, and the



presence of vitamins is also essential to health. The chief vitamins are: vitamin A, which is fat soluble and present in green vegetables, cod-liver oil, milk, butter, and eggs; vitamin B (recently discovered to be really a series), water soluble, present in eggs, yeast, liver, fish roe, nuts, and various cereal grains; vitamin C, present in fresh fruits and vegetables; vitamin D, fat-soluble, occurring in cod-liver oil, milk, butter, and cheese; and vitamin E, which is present in seeds, green leaves, and animal tissues. Absence of A causes growth deficiency and malnutrition, absence of B, beri-beri, absence of C, scurvy, absence of D, rickets, and the absence of E, sterility.

The above are a few of the facts which are important ecologically but the whole subject of dieting, on which there is an increasing literature, much of it unfortunately being of questionable scientific value, is of supreme ecological importance, especially in connexion with man's responses to his physico-chemical or internal environment. In a more general way, as already explained, the securing of his necessary food supply from his environment is to be regarded as the master factor in his ecological differentiation and classification.

#### RESPONSE TO CLIMATE AS A WHOLE

Ellsworth Huntington, who has been quoted several times above, is the author of a number of important works on this subject, including *The Climatic Factor as Illustrated in Arid America* (1914), to which Schuchert, Douglas, and Küllmer also made contributions, and *Civilization and Climate* (1915), which deals with the whole question of man's response to climate very fully. In a later work, *The Character of Races*, he laid more stress on other factors connected with race and culture development, but he is best known for his work on the purely geographical environment. Huntington's conclusions were based on experimental methods. He tested the working capacity of over 500 factory operatives in cities of Connecticut, 4,000 in southern cities from Virginia to Florida, and over 1,700 students of the Naval Academy at Annapolis and the Military Academy at West Point; in most cases each person's record covered a whole year or at least an academic year, and all the records were compared with the various conditions of the weather.

Apart from such results as have already been quoted, Huntingdon showed that (except in Florida) neither winter nor summer is the most favourable season. Both physical and mental activity reach pronounced maxima in the spring and autumn, with minima in mid-winter and mid-summer. Another point established and stressed by Huntingdon is that people do not work well when conditions, especially temperature, remain constant. Great changes are also unfavourable. The ideal conditions are moderate changes, especially a cooling of the air at frequent intervals. But even a moderate increase of temperature is better than no change. When the temperature falls greatly mental work seems to suffer more than physical. Huntingdon carefully followed the comparative effects produced by the usual succession of cloudy weather and rain storms followed by clear, sunny weather, and then cloud and rain again, and so on. Contrary to common impression, the first clear day showed the slowest work. Psychological impressions apparently do not coincide with physiological reactions. Whatever people may feel, the figures seem to show that, during an average 'spell of weather', they are least efficient on the clear days, moderately efficient on partly cloudy days, and most efficient at the end of a storm.

According to Huntingdon, 'each storm, with its changing skies, varying humidity and slow rise and rapid fall of temperature, is a stimulant. Each raises our efficiency.'

On the basis of his experimental data Huntingdon goes on to construct what he considers the ideal climate. It is one in which the mean temperature never falls below the mental optimum of 38 degrees or rises above the physical optimum of 60 degrees or possibly 65 degrees. It should have cool but not cold winters as a mental stimulus. Relative humidity must also be considered. Even if the temperatures are ideal an excess or deficiency of moisture will act adversely. The ideal climate should have a fairly high humidity, except in warm weather. Still more important than relative humidity are changes of temperature from day to day, which depend on the range of temperatures and the number of cyclonic storms. The changes must occur but must not be too extreme. When the winters are cold and the summers hot, daily changes tend

to be also very great, e.g. in the Dakotas, where the mean temperatures of January and July differ by  $60^{\circ}$  F., a change of equal magnitude may take place in twenty-four hours. In the tropical equatorial belt, on the other hand, as we have seen, both seasonal and daily changes of temperature are equally slight. The number of cyclonic storms Huntingdon considers to be perhaps more important than the range of temperatures. It is a defect in a climate if it is too uniformly stimulating. It leads, according to statistics, among other things, to nervous disorders and a high rate of suicide. A population requires to be alternately stimulated and relaxed by frequent changes from day to day. It is interesting to note that Huntingdon finds that England apparently comes nearer the to ideal than any other place. Japan also approaches the ideal climate except in the southern parts. In the Southern hemisphere New Zealand has the best climate. No climate is quite ideal. In England there are often too prolonged periods of monotonous dampness. In the United States the winters are too cold and the summers too hot.

Huntingdon went on to construct a 'Map of Climatic Energy' for the world, showing how human energy would be distributed if it depended wholly on climate. The 'very high' areas occur in the United States east of the Rockies, and Canada on the one hand, and in western Europe on the other. The distribution of civilization, Huntingdon claims to have demonstrated, follows very closely the map of climatic energy.

It is of course, admitted that climate is only one of the factors influencing the growth of civilization. Geographical position is undoubtedly very important, as are also geological structure, topography, and water and soil conditions. Race and the social environment also play a very important part. The subject of climatic changes in the past is still somewhat controversial. Huntingdon supports the view that climatic pulsations have taken place. The rise and fall of former civilizations, and the shifting of centres of civilization, may be explained by past climatic changes and particularly by a shifting of the belt of storms. To this kind of study Huntingdon and his associates have devoted a great deal of attention. It links up the study of present-day ecology with the history of the past.

Man's response to climate is partly physiological, partly psychological, but, on the whole more passive than his response to other environmental factors. The living environment of plants and animals, on the other hand, is much more under man's control, and his main relationship to it, as we have seen, is through his food supply and clothing. Similarly he uses the minerals and rocks and inorganic matter in general for his service. Water as a geographical factor, apart from climate, is of great importance but it also influences man's activities. His response to such factors of his environment, had, therefore, better be considered in connexion with his active work, rather than in connexion with his more passive physiological responses. But there is one relationship to his plant and animal environment which largely involves the question of maladjustment, viz. his relationship to disease-causing organisms. It is true that man does his best to control disease, and civilized man is succeeding more and more in prolonging life, yet diseases act in many ways like the climatic factors—on which many of them in turn depend.

#### MALADJUSTMENT TO THE ENVIRONMENT. MAN'S DISEASES

The aim of modern medicine is to prevent rather than to cure disease. Attention has, therefore, been given to the search for causes rather than cures, since a knowledge of causation is a necessary preliminary to successful prevention. The whole development of modern medicine tends to emphasize the environment—function—organism relationship and the importance of ecology. Tuberculosis, diphtheria, enteric fever, cholera, plague, pneumonia, syphilis, and many other diseases are caused by bacteria (including the spirochaetes). A few diseases, e.g. actinomycosis and ringworm, are caused by fungi. Some of the most troublesome, widespread, and persistent diseases of all are caused by protozoa and other lower forms of animal life. Mosquitoes and other insects, by acting as intermediary hosts, play an important part in the causation of several distinct diseases. All are part of man's living environment.

It is, of course, impossible here to enter very fully into this very large subject, but a few references to the more important and widespread diseases, by way of example, will



help to make clear its ecological significance. Many of the diseases that are to-day regarded as tropical were once widespread. Bubonic plague, for instance, for centuries occurred in England and the rest of Europe, sometimes more or less obscurely, but every now and then becoming epidemic. In England the last epidemic occurrence was in 1679, but previous to that the 'Black Death' overran all Europe, reaching England in 1348, where it continued till 1357. The mortality was so great that it has been variously estimated that from one-third to three-fourths of the European population perished, though the latter figure is almost certainly too high. Subsequent outbreaks occurred in 1466, 1563-4, 1580, 1592, 1603, 1625, 1636, and the Great Plague of London in 1664-5 was responsible for the death of about 70,000 people in one year out of a population of less than half a million. Cholera was common enough also in England at one time; so was malaria. There were serious outbreaks of cholera in England in 1854 and 1866 and cases occurred as late as 1893. These and other diseases prevail when man is living under primitive conditions, and they are not merely to be correlated with a tropical climate, or with any particular type of climate, though warm, moist conditions may favour the growth of the parasites concerned, as they do all types of vegetable life.

The tropics also, however, have a more numerous and varied insect life and, where insects are concerned as intermediary hosts of parasites, such diseases tend to be more prevalent in, or confined to, the tropics.

*Malaria* or *Ague* is a disease caused by protozoa transmitted by the bites of anopheline mosquitoes. At the present time foci of infection are more prevalent in the tropics and lessen towards the poles, yet the disease still has a worldwide incidence, occurring in practically all countries from time to time. The disease is treated by administering quinine, but its prevention is attempted by dealing with the mosquitoes and their breeding, through draining swamps, or covering water surfaces with oil, or living in mosquito-proof houses, &c. The whole work of Ross, in his pioneer discoveries regarding the role of mosquitoes in malaria, affords a fine example of ecological technique, and the modern



methods of controlling malaria tend to become more and more ecological.

*Yellow Fever* is a bacterial or virus disease also transmitted by mosquitoes. For four hundred years it claimed more than 50 per cent. of those attacked as victims. To-day it has been stamped out in all temperate regions and even in some of its most noted endemic centres in South and Central America, though there was a serious outbreak in Brazil in 1928. The method of destroying mosquito larvae by oil has been largely given up in this case and, instead, small fish (minnows) are placed in the tanks which serve as the water supply to the houses. The fish devour the larvae.

*Bilharziasis* (or *Schistosomiasis*) is caused by the hook worms (*Necator americanus* and *ANKLYOSTOMA* spp.). Infective larvae which live in the soil pierce the skin and ultimately reach the small intestine. Soil is re-infected by the eggs which pass out in man's excrement. Many millions of people are infected throughout the tropics and even a slight infection handicaps the apparently healthy.

*Sleeping Sickness* is due to protozoal parasites (*Trypanosoma gambiense* and *T. rhodesiense*) transmitted by the tsetse-flies (*Glossina palpalis* and *Glossina morsitans*). Large tracts of central and eastern Africa have been practically depopulated by this disease. In five years, from 1901 to 1906, it has been reckoned, 200,000 natives of Uganda, where the disease was previously unknown, died of it. Another species, *Trypanosoma brucei* transmitted by *Glossina morsitans*, causes the disease Nagana in cattle.

These are some examples of infective diseases which advancing knowledge will probably some day eradicate. Even to-day cholera and plague can be stayed by prophylactic vaccines. Anti-typhoid inoculation was one of the triumphs of the Great War (Macarthur, 1929).

It is obvious that many diseases are more prevalent in the tropics, but others are more characteristic of colder climates, e.g. typhus fever, which is a louse-borne disease, and common colds, which often lead on to more serious lung diseases pleurisy, bronchitis, and pneumonia. Influenza and pneumonic plague are also diseases of colder climates rather than warmer. Tuberculosis is prevalent in cold damp climates

and is often cured by a removal to a dry sunny region. There has, however, been a very marked and continual fall in the mortality from this disease in all civilized countries during the last century. In England in 1838 the death rate from tuberculosis was 4,419 per million persons living; in 1926 it had fallen to 961. This may be due to better living conditions and a better understanding of the value of fresh air and sunshine, or it may be due to 'acquired immunity', which is known to play a part in most other diseases as well, including tropical diseases among native tropical peoples.

The question of natural immunity has a still wider ecological significance. The importance of immunity, whether natural or acquired, is illustrated by such facts as that, whereas measles in most countries is a relatively mild disease of childhood, in Fiji in 1875 it was estimated that about one-fourth of the inhabitants died from this disease within three months.

Reference has already been made to the ecological study of deficiency diseases of domestic animals in South Africa, where the soil is poor in phosphates. If the element phosphorus is supplied direct to the animals, by feeding them a small daily ration of bone-meal, they quickly recover. In man there are also deficiency diseases, e.g. cretinism and goitre, where there is a deficiency of iodine in the thyroid tissue, and the several diseases due to deficiency of vitamins. The relationship of environment and disease in these cases is very clear. The water in goitrous regions is hard, and poor in iodine, and the disease can be successfully prevented by the administration of iodine. The case of asthma is not quite so obvious, but it is now known to be a disease of an anaphylactic nature, due to a person being sensitive to some particular substance of protein origin. Hay fever due to pollen is of a similar anaphylactic nature.

Enough examples have been quoted and enough has been said to show how close is the relationship between environment and disease, not only in the causative organisms themselves but also in the way in which the other environmental factors favour or hinder the spread of each disease.

The more the functional relationship between living beings and their environment is studied, the more intricate in many ways the relationship is seen to be. Many effects are com-

monly attributed to climate directly that are really to be ascribed to disease-causing organisms which are favoured by particular climatic or physical conditions. To obtain a true understanding of life problems the whole environmental complex has to be analysed and the true inter-relationships of the different factors as far as possible determined. If the object is to prevent some particular effect, e.g. such a disease as malaria, then the environmental complex can be attacked at any point. Swamps may be drained, or the breeding of mosquitoes, or the infection of the mosquitoes, or the infection of human beings themselves prevented, or the protozoa in the blood-stream may be killed. On the other hand, for life to run smoothly, for the living organism to remain healthy in the highest degree, the environmental complex must be made as perfect as possible. Unfortunately we have still a long way to go before we can even hope to understand what really constitutes perfection of the environment.

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## HUMAN ECOLOGY AND PSYCHOLOGY

Introductory—The Pre-experimental Stage of Psychology—Experimental Psychology—Contemporary Psychology—Introspective Psychology—Gestalt Psychology—Behaviourism—Psycho-analysis and Analytical Psychology—Purposivism or Hormic Psychology—Child Psychology—Mental Testing—Social Psychology—Bibliography.

## INTRODUCTORY

UP to the present we have, for the most part, considered only man's passive responses to his environment. Before we can go on to discuss his active intelligent interference with and control over his environment it is necessary to have clear ideas regarding his psychology. As we explained in the first chapter, the plant ecologist finds it necessary to draw upon all branches of botanical science. For the human ecologist in the same way, all branches of human science are necessary and few or none of them are more important than psychology.

What is true regarding man's physiological responses to his environment is equally true regarding his psychological. The environment—function—organism triad remains just as important when, for the middle term, psychology is substituted for physiology, though this fact has not yet been very clearly recognized by psychologists. Perhaps the most primitive races of mankind, who do not reason very much about their own powers of reasoning, yet *feel* themselves to be part of their environment as their environment is part of them, come nearer to the ecological truth of things. This attitude of theirs will be more fully illustrated at a later stage and their psychology will be dealt with at the same time as their general ecological behaviour. In the present chapter, so that a proper background may be obtained, we must discuss the whole study of psychology in its relationship to human ecology.

At the outset one fact is apparent. The history of the study of psychology affords an almost exact parallel to the study of biology. To begin with it laid emphasis on only one term



of our triad and that the last one, on man himself. Even up to quite recent times psychology was commonly defined as the science of mental life, without much reference to environment. Wundt (1892) defined it in the following words, 'Psychology has to investigate that which we call internal experience, i.e. our own sensation or feeling, our thought and volition—in contradistinction to the objects of external experience, which form the subject-matter of natural science'. Other definitions are somewhat broader, but generally all the earlier workers regarded consciousness as an inner world, and, even when experimental methods were introduced, the methods of observation were by means of introspection and were confined to the individual and his reports of his own experiences. As the experimental methods progressed, psychology became less structural and more functional, and then (as among the biological sciences) the pendulum swung still more to the left and to some psychologists the environment became all-important. If the ecologist has anything to teach the psychologist it is that, while researches may be carried out on any of the separate items of the fundamental triad and valuable results obtained, the truth of the matter is that environment, function, and organism must in the end be studied as one complete whole. Otherwise life is entirely meaningless.

#### THE PRE-EXPERIMENTAL STAGES OF PSYCHOLOGY

These, in general, correspond to the study of morphology, structure and classification in the biological sciences, and for our present purpose it is sufficient to recall in very brief outline the main theories, from the seventeenth century onwards, without attempting to trace their connexion with the philosophies of the ancients, particularly of the Greeks. Descartes was a dualist and interactionist, believing in the interaction of the soul and the body, Leibnitz a dualist who believed in a 'parallelism' of mind and body without any interaction, and Spinoza a monist, who regarded body and mind as simply two ways in which the same reality is made manifest. These three distinct theories of interactionism, parallelism, and monism continued to dominate psychology until the nineteenth century was well advanced, and they deal mainly with



man himself so their value to ecology is only an indirect value. The germ of a more ecological theory is seen in the English school of 'empiricism' which was founded by Hobbes, who distinguished between innate and acquired tendencies. He regarded self-interest as the basis of conduct and may be looked on as the first 'social psychologist'.

The 'Associationists' of the eighteenth and early nineteenth century sought to reduce all mental processes to the simple process of association. All complex experiences can be analysed into their elementary associations. An idea is a complex experience, but one idea may lead to another if they have a common element. Associationism can be described as ecological just in so far as it takes cognisance of the environment. It postulates that the child has a capacity for sensory experience. By making numerous 'associations', in the course of time, it builds up its thought system. 'Associationism' has also been described as a sort of 'mental chemistry'. The development of chemistry during the nineteenth century reinforced its appeal. Opposed to the associationist view-point was the 'faculty psychology', developed most extensively in Germany. A faculty is a capacity of the soul to carry out a certain activity. The faculty psychology emphasized the innate, the associationist psychology, the acquired, and in a slightly different way this contrast is still maintained in modern psychology.

The 'transcendentalism' of Kant was opposed to 'associationism', but Herbart, in his text-book of Psychology (1816), supported the English school of structural associationism. He discussed the interaction of experiences, their competing with one another in consciousness, their combining into wholes. Ideas may be repressed from consciousness but not entirely lost. Thus we get the germ of the idea of the 'unconsciousness' which was elaborated half a century later by Janet, James, Freud, Jung, and others. Herbart used the term 'apperception mass' for all past experiences which we use when we perceive something new—the background often referred to in the present work. This concept is of great ecological significance and it has had profound influence in education.

Pestalozzi and Froebel both made important contributions

in the elaboration of it, emphasizing the objects of observation in which a child is interested and relating them to its activities. Froebel made much of the educational value of directed play and founded the *Kindergarten* type of school. The pre-experimental stage of psychology while it concentrated mainly on the last term of our triad, on man himself, did not neglect function altogether, any more than the study of morphology in biological science does so. It was, however, mainly introspective. The psychologist studied mind and its functioning it is true, but it was his own mind that he studied and, as Tansley (1920) has pointed out, 'the very faculty which enables a man to become a psychologist gives him somewhat abnormal material on which to work'.

#### EXPERIMENTAL PSYCHOLOGY

Advances in the physical and biological sciences during the nineteenth century and the elaboration of the experimental methods of science generally, at length had a far-reaching effect on the study of psychology. In Germany, from about 1820 onwards, E. H. Weber carried out researches on the higher senses of man, the senses of smell, and of temperature, on vision and hearing, and on muscle sense. As a result of his work quantitative methods became firmly established. His name is associated with the principle that discrimination depends, not on the absolute difference of stimulus magnitudes, but on their relation to one another. He framed the hypothesis that we can lay down for each of the senses a constant fraction for 'just noticeable differences'. A quarter of a century later Fechner extended enormously the experimental work on this subject of the relationship between stimulus and reaction and deduced the general mathematical formula  $S = C \log R$ , where  $S$  is the sensation,  $R$  is the stimulus, and  $C$  is a constant for each of the senses. This means that the effects of stimuli are not absolute, but relative to the amount of sensation already existing. If the difference in illumination between 4 and 5 candles is just noticeable then the difference between 40 and 50 will also be noticeable, but not that between 40 and 49. This, applied to other senses as well, has become known as the Weber-Fechner Law.

It is impossible to refer to more than a few of the other earlier experimenters, but Galton's work on *Hereditary Genius* led the way in the application of the pedigree methods of studying mental endowment, and his experiments on 'free association' were the first of their kind, notwithstanding the fact that associationism had held the field for so long. Wundt, and later on the psycho-analysts, have elaborated Galton's free association methods, but even his early experiments were sufficient to demonstrate the importance of the influence of early childhood on adult mental development. Galton also devoted attention to 'mental imagery' which was afterwards the subject of much psychological research in Germany and America.

From the ecological standpoint, Galton is particularly noteworthy as the founder of Eugenics. Finally, Galton performed a service of the greatest magnitude to biological science, as well as to psychology, by his quantitative methods and his development of the use of statistics. The first use of the 'coefficient of correlation' was Galton's. It is being more and more used in all kinds of comparative experimental studies, though the methods of working it out and other mathematical refinements have been elaborated by Galton's pupil, Karl Pearson, and by Elderton, Sheppard, Irvine Fisher, R. A. Fisher, Bowley, and others.

The study of psychiatry, including psychoses (insanity), mental deficiency, and psycho-neuroses (functional nervous disorders) made considerable progress during the nineteenth century, particularly in France. Mesmer, an Austrian student of medicine, gave his name to the phenomenon of 'mesmerism', which became a popular fad during the early part of the century, and from it the theory of suggestion was developed by Liebeault and Bernheim, the founders of the 'Nancy School'. The auto-suggestion of the new Nancy School is sometimes referred to as 'Couéism', after Coué, its best known exponent. Purely hypnotic methods were elaborated by Charcot at Paris. In Germany more orthodox experimental methods were continued by Helmholtz who worked on reaction time, hearing and vision; by Hering who worked on similar lines, but, according to Murphy, made it his duty to disagree with Helmholtz or some other authority

on everything; by Lotze and others. Finally Wundt in the establishing of the first experimental psychological laboratory at Leipzig had a profound influence on the modern experimental development of the subject. Wundt was born in 1832 and lived until 1920. He extended and systematized the experimental work on problems that had already received attention—reaction time, vision, hearing, &c. He devoted attention to folk ‘psychology’, and the psychological interpretation of language, and other problems that afterwards received much fuller treatment. He unified the whole field of research on psychology in a remarkable way and he trained many pupils who afterwards occupied important teaching posts in various countries and especially in America. The laboratory methods were continued and separate psychological laboratories were established. In the course of time, at most universities of the world, psychology was recognized as an experimental science and laboratories became more and more well equipped.

It must not, however, be assumed that because the experimental method was adopted by psychology it all at once became entirely functional in its outlook. Wundt was emphatic on the point that the experimental laboratory was not designed in the least to do away with introspection, but rather to afford the best facilities for accurate and minute introspection. Wundt, himself, and some of his best-known spiritual successors, e.g. Titchener of Cornell, remained structuralists, studying mental states, sensations, images, and feelings, even if they used quantitative methods of measurement. They were, and still are, more interested in mental structures than in mental processes or functions. To give the impression that psychology began by studying structure and morphology, went on to study function, and ended up by studying environment would be to present a very false picture of what really happened. As among the biological sciences, there are some who remain most interested in comparative morphology, others who are devoted to functional studies, others who find the influence of the environment all-important. No one could find fault with their separate attitudes if only at the same time they fully realized—as unfortunately they do not always—the essential unity



of the environment, function, organism relationship. If we keep in mind the fact that specialists are very apt to view any subject as a whole with a bias determined by their specialist leanings, it will help us to understand the conflict between various modern schools of psychology and, at the same time, to appreciate the value of the contributions of each.

#### CONTEMPORARY PSYCHOLOGY

Human ecology must not only draw upon the content of all the human sciences; it also requires to adopt, wherever necessary, their methods and technique to further its objects, and, for research work in human ecology, a knowledge of the research methods of psychology is essential. In dealing, therefore, with the different schools of thought in modern psychology this fact should be borne in mind.

*Introspective Psychology.* While the experimental methods, which grew up during the nineteenth century, have continued to be used, the behaviourist school has insisted most vigorously that only objective methods have any real scientific value, the corollary being that subjective or introspective methods are valueless. Woodworth, however, has pointed out (1931) that subjective observation is not radically different from objective. Among modern schools of psychology he distinguishes an 'Existential School of Introspective Psychology'. Psychology is taken to be a science of the individual's experience, and as the fundamental aim of science is description, psychology aims to describe the individual's experience, to analyse experiences, to compare and classify them, to arrange them in an orderly system. Experiences are studied as *existences*, as facts deserving of description, analysis and classification just on their own account, and not for any light they may throw on the individual's performances. At least one school of modern psychology, therefore, believes in the fruitfulness of studying the last term of our triad more or less by itself.

*Gestalt Psychology.* Since there is no particular reason why the different modern schools of psychology should be arranged in any definite chronological sequence, we may next consider the Gestalt school of configurationism. This was developed in Germany by Wertheimer, Köhler, and



Koffka. We have seen that associationism dealt with analysis of complex ideas and with their building up from the simple elementary sensations. The Gestalt psychology rejects this view-point. It insists on the holistic character of psychic phenomena. Von Ehrenfels as early as 1890 had introduced the idea of 'pattern quality' or 'form quality' (*Gestaltqualität*) into psychology. He maintained that, in all perception, qualities appear which are more than the separate sensory entities, something added by the subject which is the *Gestaltqualität*. The Gestalt school, which began in 1912, went farther, and urged that the phenomenal world represents certain characteristic groupings and configurations; it has a certain order which cannot be accounted for on a summative basis. A whole is something else than the sum of its parts. In 1912 Wertheimer carried out experiments on the perception of movement and concluded that motion is not seen by the brain receiving successive stimuli, and then synthesizing them into a perception of motion. Perception of motion is a perception *per se*. Motion is not inferred but is actually directly sensed by the primary receptive process of the brain. Extending the Gestalt idea, spatial forms are seen as wholes, melodies are heard as wholes and so on. The processes in the brain are not summations of separate excitations but integrated processes. The Gestalt psychologist regards the configuration or pattern as the ultimate fact of psychology. He objects to atomistic views, he dislikes the attempt to analyse behaviour into the units of stimulus and response. Adjustments to the environment involve, he maintains, sensory as well as motor organization, both being part of the total activity of the organism. Kluver (in Murphy, 1930) gives it as his opinion that the two most characteristic features of the Gestalt psychology are the insistence on 'phenomenal analysis' and on a non-mechanical account of organic processes and of the organism. Gestalt psychology is full of interest to the ecologist, who himself insists that environment, function, and organism has a wholeness of its own.

*Behaviourism*. It may be well to consider next one of the most revolutionary of all the modern schools, that of behaviourism. The term behaviourism was introduced by Watson to represent the type of psychology which he defined as

follows (1914). 'Psychology, as the behaviourist views it, is a purely objective experimental branch of natural science. Its theoretical goal is the prediction and control of behaviour. Introspection forms no essential part of its methods, nor is the scientific value of its data dependent upon the readiness with which they lend themselves to interpretation in terms of consciousness.' Behaviourism deals entirely in terms of stimulus and response, in terms of habit formation, habit integration and the like. It discards all reference to consciousness. There is no compromise about behaviourism as Watson defines it.

Though the school is usually considered to have been founded by Watson, its outlook and methods were largely influenced by the workers on animal psychology and behaviour, in which subject Watson himself had specialized. Thorndike had experimented largely on animal instinct and learning, using mazes, trick cages, and 'puzzle boxes'. Thorndike concluded that his animals did not learn by reasoning, but by 'trial and error' methods. Animals, according to him, learn by doing. Thorndike's work, however, did little more than prepare the way for behaviourism. It may be noted in passing that Köhler's work (of the Gestalt school) on the mentality of apes has modified very much Thorndike's conclusions, and is used rather to support the Gestalt idea.

As Woodworth remarks, behaviourism began in America as a protest rather than as a discovery. The experimental methods, however, on which the behaviourists came more and more to rely, were those initiated by the Russians, Bechterev, who worked on motor reflexes, and particularly Pavlov who dealt with glandular or secretory reflexes. They reached conclusions which enabled them to frame the concept of what Bechterev called 'associated reflexes' and Pavlov 'conditioned reflexes'. Pavlov, working on the physiology of digestion, noticed that there was a flow of saliva in a dog before food was placed in his mouth. The sight of food or the sound of footsteps of a person bringing food was enough to give the response. In his experiments he found that, if the sound of a bell was associated with the giving of food, after a time the sound of the bell by itself was enough to induce the flow of saliva. A 'conditioned reflex' is the term he applied to a

reflex in which the response is due to such a substituted stimulus. Much experimental work was done on the times necessary to establish a conditioned reflex and on the times necessary to extinguish or eradicate a conditioned reflex once established. Establishment was regarded as a positive response, extinction a negative or inhibitory response of the same brain mechanism. Elaborate work was also done on the process of the differentiation of responses to similar stimuli of different intensities.

The brain according to Pavlov has two functions. It can pick out stimuli on the sensory side and on the motor side its function consists of conditioned reflexes. All learned behaviour consists of conditioned reflexes.

Several authors have described thinking as mental experimentation. Ideas and attitudes are manipulated by a trial and error method. The processes bear a close relationship to language mechanisms and the behaviourist regards thinking as speech movements made on a very small scale and substituted for overt acts. Thought processes in terms of language, through the conditioned response, serve in place of similarly conditioned overt acts. Thus for the association of ideas the behaviourist substitutes ordered motor responses.

As regards emotion, Watson considers that it consists in profound changes of the bodily mechanism as a whole but particularly of the visceral and glandular systems. Each separate emotion is a particular pattern of such changes. In infants Watson finds only three well-marked patterns of emotional behaviour, fear, rage, and love. The original stimuli for these are, for fear, a loud sound or falling, for rage, hampering the child's freedom of movement, for love, patting and stroking. But by conditioning, other stimuli if associated at first with one of the original stimuli, will call forth the same responses, e.g. conditioned fear responses to contact with animals. This shows how many irrational fears, hates, or loves of children may originate.

Watson rejects instinct and innate traits as an explanation of temperament or behaviour. Given a normal child, he claims that by proper conditioning he can be turned into anything you please 'regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors'.

It is clear, then, that for the extreme behaviourists environment is all-important. The majority are not likely to go so far as they do, yet the behaviourists, by their challenging attitude, have succeeded in inducing psychologists to come round and have a look at the ecological triad from the opposite end to that which for so long they had chosen, from the environment end rather than from the organism end. What the ecologist would prefer is that they should regard the triad as a whole, or, if they must adopt a special viewpoint, they should try looking at it not from either end but sideways.

*Psycho-analysis and Analytical Psychology.* The study of Psycho-analysis arose from psychiatry, and is associated, first of all, with the name of Sigmund Freud of Vienna. To a large extent it completely ignores the orthodox academic psychology, but lays great emphasis on the unconscious. It has already been mentioned that the study of hypnotism and hypnotic methods had been developed by Charcot at Paris. Charcot was the leading neurologist of his day (1825-93). Morton Prince of Boston was one of his pupils, well known for his work on multiple personalities or split consciousness. Pierre Janet of Paris also developed Charcot's methods of treating neuroses by means of hypnotism and suggestion. Freud became a pupil of Charcot's and after his return to Vienna collaborated with Breuer, continuing to use hypnosis for a time, but afterwards developing a 'talking out' method without hypnotism, the origin of psycho-analysis. Patients suffering from hysteria, neurasthenia, or other mental trouble, as the result of mental conflict, were helped gradually to recall forgotten emotional episodes which had induced the conflict, and through the release of pent-up emotion a cure was often effected. The 'talking out' method was called 'mental catharsis' because it eliminated the source of trouble from the mind. The methods pursued by Freud were those of free association, which, as we have seen, were originated by Galton, and later the patient's dreams were found to be of significance. Painful experiences, or those which caused shame and consequently were repressed, were thus brought up from the unconscious into consciousness. As time went on, and as the result of continued use of his methods, Freud



discovered that suppressed desires and complexes were usually of a sexual nature; probing farther, he found that they were most troublesome when they went back to early childhood, and found, moreover, that they were not necessarily the result of actual happenings, but of infantile or childish unfulfilled wishes. When the early emotions are revived the process of transference takes place, the analyst becoming a substitute for the person who caused the earlier emotional disturbances. At certain stages the patient shows an exaggerated love for the analyst, at other stages equally exaggerated hate, but as the analysis approaches completion love predominates. The final task of the analyst is to wean the patient away from this childish attitude of dependence, to interest him rather in his everyday affairs and so effect a final cure.

So much for the actual methods of treatment. Freud's psychology goes much farther and in some respects has little to do with the actual practice of psycho-analysis though it is based on this. Most of it is based on theory, though Freud himself regards it throughout as based on fact. As Woodworth clearly points out, one guiding principle is that what is forbidden must be desired. Unless people desire something it would never have to be forbidden. What is most strictly forbidden is most strongly desired. What is abhorrent and shocking must be strongly desired, e.g. parricide, incest, abnormal sexual relations. Hidden primitive desires, because they are condemned by society, are most rigidly suppressed. Another guiding principle is that what is feared is probably desired, the fear being a mask for the desire. Freud, therefore regards repression as fundamental in psycho-analysis. Neuroses are due to desires and their repression. Infantile sexuality is equally fundamental.

Neurotic symptoms are not signs of weakness but are positive wish fulfilments. Desires which cause horror to the conscious mind and are instantly repressed retain their force in the unconscious and seek fulfilment. This Freud calls 'conversion' of a desire into a physical symptom. In his *Psychopathology of Every-day Life*, Freud gives many examples, e.g. slips of the tongue, errors of omission, of substitution, transposition, &c., as illustrations of positive wish fulfilments. His theory of dreams is similar. Dreams reveal the

dreamer's past and, as already mentioned, are made use of in the process of psycho-analysis.

All this can be summed up, as McDougall has pointed out, by noting that the essential thing about Freud's psychology is its insistence on motivation. Mental events do not happen without causes, and for Freud the cause is a wish or motive.

Woodworth is of the opinion that Freud's assumption of universal psychic causation, his assumption that all activity is motivated, is more fundamental in his psychology than his doctrine of repression. Freud also makes another assumption which is fundamental, that particular desires once active live on in the individual.

Another point requiring emphasis is the fact that Freud attaches a very wide meaning to sexuality, including in it what is commonly understood by love, yet at the same time he insists that it is all strictly and genuinely sexual. For him the 'libido' is sexual force. It is probably by his insistence on this that Freud has done so much to call popular attention to his theories, and he has succeeded (as Woodworth puts it) in 'opening the door to a rational consideration of personal problems'. Many of his concepts have been found useful in the study of personality, e.g. 'mental mechanisms', 'defence mechanisms', the 'rationalization of unacceptable desire' and 'sublimation' (the finding of a suitable social outlet for desires which cannot be allowed direct expression). One other characteristic of Freud's own personal psychology is noted by Woodworth as exemplified in his later books, his regard for duality or polarity. Like many others he has a mind which likes dichotomous classification. He contrasts the 'libido' with the 'ego', i.e. the sexual instincts, which are directed towards an object, with the self or ego instincts. Libido, however, he came later to see, is often withdrawn from the object and directed towards the ego, so as a further step he recognized the sexual and ego instincts as the Eros the all-sustaining, which combines all the instincts for self-preservation, and for the preservation of the species in one. He maintained his dichotomy by contrasting this with the instinct of death or destruction which works in silence. The death instincts are by nature mute, the clamour of life pro-

ceeds for the most part from the Eros. Freud is essentially an empirical investigator. His methods are objective, he possesses a real genius for analysis, and through his analytical methods and technique he opened up the way to the study of the unconscious, but he has shown far less ability to form general concepts. In this he differs from C. E. Jung of Zürich who is much more of the philosophical type.

Even among Freud's immediate associates at Vienna were some who came to differ from him in essential points. Most prominent among these is Alfred Adler who emphasized the 'ego' rather than the 'libido' and believed from the start that Freud laid far too much emphasis on sexuality. For Adler the fundamental fact in neurosis is the feeling of inferiority, 'inferiority complexes'. He regards the self-assertive impulse, the 'will for power', as stronger than the sex impulse. He is as much a 'motivationist' as Freud but for him the fundamental psychical causes are different. One of the most interesting of the points emphasized by Adler and his followers is their theory of compensation. Many temperamental characteristics may be compensations or defence reactions against unconscious or instinctive trends in the opposite direction, e.g. pronounced egotism is a defence against a sense of inferiority, prudishness is a defence against amorousness, courage against timidity, &c.

Jung's name is associated with what he calls 'analytical psychology' and regards as distinct from Freud's psychoanalysis. He differs from Freud in not seeking for the causes of neurosis in the past, but in the present. He uses the same methods of free association and dream analysis, but he studies the patient's present problems and his attitude towards them. He seeks to integrate the unconscious with the conscious so as to give the patient an understanding of his present state. He differs also from Freud in other equally fundamental ways. For Jung the 'libido' has a different meaning; it is a general urge like the 'will to live' of Schopenhauer or the *élan vital* of Bergson. It is the energy of the mind seeking an outlet in activity. It includes both sexual urge and the ego instinct or 'will to power'. Jung's libido, like physical energy, seeks an end point of equilibrium.

Jung, as already remarked, was much more inclined to

generalize, and this tendency of his led him on to his crowning work on *Psychological Types* or *The Psychology of Individuation*. He is like Freud, however, in one respect. He, too, has a fondness for dichotomy. He divides all mankind into two types 'introverts' and 'extroverts'. The introvert is turned inwards. He is governed by subjective factors, he interposes a subjective view between the object and his own action, he selects subjective determinants as the decisive ones. In introversion the libido flows inwards towards the individual himself. The extrovert so thinks and feels and acts or, in a word, so lives as to correspond directly with objective conditions. The objective rather than the subjective plays the greater role in his consciousness. He looks outward towards the world, his libido flows outward. Jung proceeds to elaborate the contrast between introverts and extroverts at great length and further to subdivide each of them into (a) Thinking types, (b) Feeling types, (c) Sensation types, and (d) Intuitive types, making eight types altogether. Though Jung's classification has received a good deal of popular attention, psychologists in general have, on the whole, remained somewhat sceptical about the possibility of classifying mankind in this way. There are plenty of examples of extreme types no doubt, but the vast majority are probably mixed in this, as in other things. Jung's suggestion, however, that conscious extroverts are probably introverts in their unconscious, and vice versa, is very interesting. As regards psycho-analysis and analytical psychology as a whole, this school, in many ways, comes nearer to the ecological ideal than any of the others. In a sense it is a behaviour psychology, but it differs widely from 'behaviourism'. It recognizes the importance of the environment, but it concentrates equally on the individual and his functions. Yet it is a special psychology, indeed it has little use for the academic psychology. It has variously been described as a 'feeling' psychology as distinct from the merely intellectual, or as a 'depth' psychology because of its emphasis on the importance of the unconscious. It is also, in a general way, covered by the next school to be considered, hormic psychology.

*Purposivism or Hormic psychology.* The name 'horme' (Greek ὁρμη) is applied to the element of drive or urge or



felt tendency towards an end. When conscious it is called 'conation', but it is wider than conation; it belongs to the unconscious as well. All purposive activities of the organism are hormic processes. Psycho-analysis, therefore, throws light on hormic psychology by bringing to light unconscious purposive factors. The chief representative of hormic psychology is William McDougall, and from our present standpoint it is particularly important to note that he was led to adopt it, not only because he objected to the one-sided intellectualism of academic psychology, but because he set out to provide a psychology which would be of use to the social sciences, when he published in 1908 his *Introduction to Social Psychology*. Like Freud, McDougall was guided by motivation, but for him the primary motives were the instincts. He analyses an instinct into three main phases; (1) on the receptive side, it is a predisposition to notice certain stimuli that arouse activity (2) on the executive side it is a predisposition to make certain movements or to produce certain changes in the situation, and (3) between the receptive and the executive sides is the emotion, the core of the whole instinct. In his work, published in 1923, he gives the following list of major instincts and their accompanying emotions or feelings; (1) the instinct to escape from danger, with the emotion of fear, (2) the instinct of combat, with anger, (3) repugnance and disgust, (4) parental instinct and tenderness, (5) instinctive cry of distress and helplessness, (6) sex instinct and sex emotion, (7) curiosity, (8) submission and humility, (9) self-assertion and superiority, (10) seeking company (herd instinct) and loneliness, (11) food seeking and appetite for food, (12) hoarding instinct and ownership, (13) constructive instinct and creativeness, (14) laughter with feeling of amusement.

Instincts are not acquired but inherited. Further, McDougall maintains that behaviour, objectively considered, shows goal seeking. Goal seeking requires motives and the motives are the instincts. At the same time, McDougall did not overlook the importance of learning. Instincts may be, and are, modified by learning, or conditioning as the behaviourists would say, and the learning may take place both on the sensory and motor sides. The emotion, however, remains

unchanged. Instincts are not only capable of being modified but they also become combined into attitudes and sentiments, in the course of the individual's experience. Social behaviour is based, not on a single social instinct, but on many or all of the instincts. A child develops sentiments towards individuals or institutions that arouse varying emotions, and particularly he develops a sentiment towards himself, based chiefly on two instincts, self-assertion and submission. Thorndike (1913), though he extended McDougall's list of instincts, criticized his views in many respects and rejected the emotions as being the unchanging core of the instincts. He classified instincts rather in terms of the types of unlearned, overt behaviour shown. In England, however, Graham Wallas and many others followed McDougall more or less closely.

T. Percy Nunn (1921), in a work on *Education: its Data and First Principles*, works out in a very ingenious way the relations between hormone and mneme (the latter meaning all the varied phenomena referred by Butler to memory, conscious and unconscious). 'Every act of self-assertion is both hormic and mnemonic: hormic in so far as it is an instance of the conservative or creative activity which is the essence of life, mnemonic in so far as its form is, at least partly, shaped by the organism's individual or racial history.' While McDougall's doctrine of instincts was at first welcomed by psychologists and sociologists alike, as time went on, it began to be more and more called in question by some, while continuing to be supported by others. Sociologists and anthropologists think naturally in terms of culture, which is a group culture imposed on the individual and learned by him but not inherited. A controversy on the whole subject began about 1919 and culminated in 1924, when L. L. Bernard published his book on *Instinct: A Study of Social Psychology*. He showed how no two psychologists give the same list of instincts, that there is little agreement as to the usage of the term instinct, and what are called instincts are more often than not learned activities and not inherited. Bernard stresses the environment (especially the social environment) as determining the individual's behaviour in the main.

Among psychologists themselves the hormic school is

also clearly at the opposite pole from the behaviourist. The latter regards all bodily actions and all phases of experience as mechanical reactions to stimuli, the former insists on motivation and on purposive responses. The behaviourist looks at our ecological triad from the environmental and the purposivist looks at it most distinctly from the organism end. McDougall refuses any compromise. He still regards active striving towards a goal as a fundamental category of psychology, and as a process of a type that cannot be mechanistically explained or resolved into mechanistic sequences. Purposive activity is known to us as mental activity with perception of the situation, anticipation of the effects produced, striving towards the goal and satisfaction when the goal is reached. This is all frank teleology and McDougall, in one of his latest works (1929) thinks that the fact of purpose in psychology is in itself sufficient to establish teleological causation. He is inclined to extend it to all living phenomena.

Though the above represent some of the more distinct 'schools' of contemporary psychology, there are others who have adopted special view-points, some of them interesting and fruitful. Felix Krueger of Leipzig has worked out a 'developmental psychology' which differs from the Gestalt school in its emphasis on the developmental side, cultural facts, social conditions, and especially in insisting that, while the 'total quality' of the Gestalt dominates the qualities of the parts, these parts, the sub-wholes, have a different 'weight' and participate to a different degree in the total quality of the Gestalt. The configuration (Gestalt), moreover, is embedded in a total feeling and this feeling is more fundamental than the configuration itself. E. R. Jaensch of Marburg has developed a special school which deals with visual perception. Life-like images are called 'eidetic images'. Eidetic individuals are those who have the power of seeing objects 'in the real sense of the word' when, having once viewed them attentively, they look away or shut their eyes. Eidetic images have been called 'pseudo-hallucinations'. They can sometimes arise spontaneously or at will without previous viewing of an object. They are not regarded as pathological. There are various degrees of eidetic imagery

from weak to strong. The power of seeing 'eidetic images' is common among young people, not so common among adults and it has been maintained that the eidetic stage is to a certain extent a normal stage of development. Jaensch lays considerable stress on the genetic aspect of his researches in this field. If the eidetic stage is a normal stage in development, and if the presence of eidetic imagery points to other typical characteristics of the individual, then Jaensch is right in believing that eidetic research from a genetic point of view is of importance for certain problems of biology, sociology, mythology, pedagogy, art, and even philology.

William Stern has developed a 'personalistic' psychology and philosophy. Neither conscious processes nor behaviour but the undivided totality of 'person' is made the point of departure. In defining 'person' (which shows unity in multiplicity) purposiveness and singularity are named as the chief characteristics. A 'person' is a purposive individual unity striving towards certain ends. So far as can be gathered from the short account given by Kluver (in Murphy 1930) of Stern's position and views, they come fairly close to those of the ecologist. The 'personalist' would go ahead with the analysis and description of behaviour without bothering overmuch about consciousness on the one hand or 'behaviourism' on the other. At the same time the personalist would admit, what the ecologist insists on, that researches on both these lines are necessary.

'Psychologically, one must realize an interdependence, a constant convergence of "person" and "environment" in the sense that on the one hand the tendencies directed towards certain ends predispose the person to select a limited part of the objective world as environment, and that, on the other hand, the objective factors in the environmental constellation decide whether or not the teleological activity of the person reaches its ends.' (Kluver.)

Integrative psychology is the term applied to the system of W. M. Marston and his associates (1928, 1931). It is somewhat difficult to summarize briefly, but essentially it regards consciousness as a highly concentrated form of energy—'psychonic energy'. This psychology seeks to use the data supplied by psychology and thus to explain experience and behaviour. It considers the human organism all



the time in relation to the environment and further reference will be made to it in our final chapter. Omitting other interesting view-points, there remain to be dealt with, not so much separate 'schools' of psychology as subdivisions of the subject or characteristic movements or applications of it.

#### CHILD PSYCHOLOGY

The literature of 'educational psychology' is too vast for any adequate summary to be given here. Only a few of the more important names associated with it can be mentioned. The work of Herbart, Froebel, and Pestalozzi has already been referred to. The German physiologist Preyer published in 1881 an important work on *The Mind of the Child*. In 1907 Stanley Hall's book on *Adolescence* became a standard work. Hall's 'recapitulation theory' was an application of Haeckel's theory that 'ontogeny repeats phylogeny'. For a time the recapitulation theory was received with enthusiasm in psychology as in biology, though it is now realized that, though it is true up to a point, it must be applied with extreme caution. A theory developed by Spencer and by Groos emphasized the importance of 'play'. Play is regarded as the exercise of instincts prior to their full development, and a preparation for adult life.

More important than all theories were the careful studies of the development of individual children from birth onwards contributed by numerous workers in this field. Maladjustments were studied in the same way. The most important experimental results obtained by J. B. Watson and the behaviourist school have been connected with the studies of reflexes present at birth and the possibility of altering original nature by means of conditional responses. During more recent years the innate acts and the time of their first appearances, the age at which various habits are acquired and the steps by which they are reached, have all been classified. It is all very important not only for child psychology but for adult psychology as well.

#### MENTAL TESTING

The attempt to measure human ability is a characteristic movement in modern psychology, but its beginnings go

quite far back. Ebbinghaus (1879-87) dealt quantitatively both with learning and forgetting, using statistical methods. To eliminate variable errors due to the *meaning* of the things learned he used nonsense syllables. His 'curve of forgetting' has become classical. Forgetting, he found, is extremely rapid in the first few minutes, less rapid in the next few hours, and still less rapid in the next few days. It becomes at length practically a straight line parallel to the axis along which the times are plotted. Though the exact form of the curve varies with different individuals its general form remains the same. Ebbinghaus interpreted his results along the lines of the association psychology. He went on to offer a theory of intelligence which he regarded as the ability to combine and integrate, and a method of testing it by his 'completion tests'. Though his theory of intelligence has not been generally accepted, his testing methods have been extensively elaborated. Towards the close of the nineteenth century Binet, in collaboration with Simon, devised tests for detecting mental deficiency, with a scale from easy to hard, representing various progressive 'mental age levels'. Goddard translated the Simon-Binet tests and adapted them for use in America. Stern introduced the 'Intelligence Quotient' (I.Q.) idea, obtained by dividing the mental age by the real age. Revisions of the Binet scale were Terman's 'Stanford Revision' of 1916 and the Yerkes-Bridges Point Scale of 1915. These were applied to schools and clinics all over the United States and to a less extent in European countries.

In England Spearman, beginning in 1904 and continuing ever since, has improved the testing technique and in particular has put forward a theory that has attracted a great deal of attention and excited a good deal of controversy. In abilities he believes there are two factors which he calls  $g$  and  $s$ , one general, one specific. The start of his inquiry was an observation made in the correlations calculated between the measurements of different abilities. The correlations tended towards a peculiar arrangement. When the letter  $r$  stands for any correlation and the letters  $a, b, p, q$ , for abilities then  $r_{ap} \times r_{bq} - r_{aq} \times r_{bp} = 0$ . This he calls the tetrad equation, and when it holds good throughout any table of correlations then every individual measurement of every ability can be divided

into two independent parts  $g$  and  $s$ .  $g$  varies freely from individual to individual but it remains the same for any one individual in respect of all correlated abilities.  $s$  varies even for any one individual from each ability to another. Although both these factors occur in every ability they need not be equally influential in all.  $g$  has a much greater relative influence or weight in some abilities than in others.  $g$  is dominant in such operations as reasoning, learning Latin or science or philosophy or in executive tasks, but it plays a small part in the arts and crafts or in distinguishing one tone from another. In general, according to a speech made by Spearman at a recent conference on examinations, ' $g$  is the less dominant in a mental process according as this depends on mere retentivity; or on any of the sensory organs with their brain tracts; or on any of the motor organs with the cerebral tracts of these. On the other hand  $g$  tends to dominate according as the performance involves the perceiving of a relation, or as it requires that relations seen in one situation should be transferred to another.' With caution Spearman does not say that  $g$  is a measure of mental energy, but he does claim that it behaves *as if* it measured an energy.  $g$  he regards as innate. It is not the product of training.

While the technique and application of intelligence testing has been extensively developed, much less attention has been given to the analysis of the nature of intelligence itself, in fact Murphy quotes Thorndike as having nicely phrased the general attitude of psychologists by saying 'intelligence is the thing that psychologists test when they test intelligence'.

The study of the inheritance of intelligence on the lines of Galton's pioneer work on *Hereditary Genius*, or of lack of intelligence (mental deficiency) as in Dugdale's well-known work on *The Jukes*, has been much affected by later discoveries in genetics on Mendelian or other lines. Intelligence seems to depend not on one but on many hereditary factors and, with the recognition of this fact, the meaning of correlation studies has been more clearly grasped. Work has been done, utilizing the Army 'Alpha' data of the U.S. Army tests, on the course of intellectual ability throughout the life span. A decrease of intelligence is shown from twenty onwards, but it is capable of various explanations

owing to selective factors entering in. There is an extensive literature on sex differences in intelligence; girls show, as is to be expected, the results of earlier adolescence, but among adults there is a slight superiority for the average score of men. Among special abilities the differences are greater on the one side or on the other. Various workers have reported superior memory in girls and women, superior ingenuity in boys and men. According to Strong, women excel in the tendency to notice and recall details. But it is difficult to say how far these differences are innate and how far cultural. The same applies to differences in suggestibility which is slightly greater for women.

The study of race differences is full of interest to the ecologist. Woodworth's performance tests carried out on different races at the St. Louis Exposition in 1904 seemed to show that the average ability of different races differed but little. The only exception was the case of the Negritoes whose abilities averaged less than the others. But the results of subsequent Negro studies in the United States show, on the average, an intelligence quotient for them about 10 points below the whites; whether due to environmental differences or not it is hard to say.

We have seen that psychologists find it hard to define exactly what they mean by intelligence. One thing, however, at least is certain. Man is not pure intellect. Intelligence tests do not test his whole nature or personality or even his ability to adjust himself to his environment. This is so obvious that it is not surprising to find that psychologists have recently been turning their attention to the testing of will and temperament generally, e.g. Downey (1927). To enter into details would take us too far, but Miss Downey's method of presenting results by means of comparative 'will profiles' is very useful and interesting. The will-temperament tests fall into three groups of four each and include A(1) Speed of Movement, (2) Freedom from Load or Inertia, (3) Flexibility, (4) Speed of Decision; B(1) Motor Impulsion, (2) Assurance or Reaction to Contradiction, (3) Resistance to Opposition, (4) Finality of Judgment; C(1) Motor Inhibition, (2) Care for Detail, (3) Co-ordination of Impulses, (4) Volitional Perseveration.



Porteus and Babcock in their work on *Temperament and Race* (1926), carried out extensive investigation on the different races represented in Hawaii, the pure Hawaiians, Chinese, Japanese, Portuguese and Filipinos, using the 'Porteus Social Rating Scale' consisting of the following Traits: (1) Lack of Planning Ability v. Planning Capacity, (2) Suggestibility v. Self-determination or Resistance to Suggestion, (3) Impulsiveness v. Prudence (4) Irresolution v. Resolution, (5) Over Emotionality v. Self-control, (6) Instability of Interest v. Stability of Interest, and (7) Obtrusiveness v. Conciliatory Attitude or Tact. These were applied through a system of securing the opinions of twenty-five people, well qualified to judge, by getting them individually to assign marks, of from one to five points, to each of the races on each of the traits, and averaging the results. Intelligence tests were also applied and the Porteus Maze test, which Porteus designed to supplement general intelligence tests. He claims that it lends itself to the purpose of measuring some temperamental and character traits. Their studies led Porteus and Babcock to adopt a position intermediate between those anthropologists, who like Boas, regard all races as potentially more or less equal but differing only in their culture, and those who hold that racial achievement depends on inborn capacity. According to Porteus and Babcock heredity deals the player the cards and experience teaches him how to play them, but in the game of life heredity means more than the mere dealing of the cards. We also inherit the capacity to learn to play them. Heredity thus plays a dual part and, on the whole, they seem inclined to assign rather more importance to it than to social environment or culture.

#### SOCIAL PSYCHOLOGY

We have seen that the study of 'folk psychology' goes back to Wundt, and since his time much work has been done on the psychology of primitive peoples; a good deal of this work has already been referred to in previous chapters. It has been largely the work of sociologists and anthropologists, but books such as Tarde's *Laws of Imitation* (1890), Le Bon's *The Crowd*, Sighele's *La foule criminelle* (1893),

and others dealt with the social psychology of our own social life.

One of the most comprehensive and up-to-date is McDougall's *The Group Mind* (1921). In his preface to this work he makes it clear that he regards his *Introduction to Social Psychology* simply as an Introduction or Foundation and not a complete treatise. The *Group Mind* is a sequel to the *Introduction*, of which one critic, he says, remarked that it may be good psychology but it is very little social. The *Group Mind* deals with 'Collective Psychology', with the mental life of the crowd and communities. While provisionally rejecting the hypothesis of a collective consciousness McDougall maintains that we can speak of the collective will and the collective mind of an organized group, e.g. the mind and will of a nation. It is possible to deny collective consciousness and still speak of a collective mind, because he defines mind as an organized system of interacting mental or psychical forces. He describes the peculiarities of simple crowds and says they tend to appear in all group life, but they are modified in proportion as the group is removed from a simple crowd. The actions of a common crowd are the immediate outcome of primary impulses, those of an organized crowd truly volitional. The conditions which render possible the formation of a higher group and a group mind are (1) some degree of continuity, (2) the forming in the minds of the members of some adequate idea of the group, of its nature, composition, functions, and capacities and of the relations of individuals to the group, (3) the interaction (especially conflict or rivalry) with other groups, though this is not an essential condition, (4) traditions, habits, and customs existing in the minds of the members and determining their relations to one another and to the group as a whole, and (5) organization of the group, consisting of the differentiation and specialization of the functions of its constituents, the individuals and classes within the group. He deals at length with the 'group spirit' which is not only highly effective in promoting the life and welfare of the group but is also a source of peculiar satisfactions. 'The group spirit plays a vastly important part in raising men above the purely animal level of conduct, in extending each man's interest beyond

the narrow circle of his own home and family, in inspiring him to efforts for the common good, in stimulating him to subordinate his private to public ends, in enabling the common man to rise at times to lofty heights of devotion and self-sacrifice.' 'The group spirit consists of two essential processes, namely, the acquisition of knowledge of the group and the formation of some sentiment of attachment to the group as such.' Knowledge of the group and the growth of group sentiment are promoted by free intercourse within the group and free intercourse between the group and other groups. McDougall goes on to deal with the peculiarities of groups. The natural are those rooted in kinship and those determined by geographical conditions, and the artificial are subdivided into purposive groups (e.g. social clubs, commercial companies, philanthropic, and other associations), traditional groups (e.g. the castes of the Hindu world, Freemasons, &c.), and mixed groups (e.g. Christian Church, Universities, &c.). This concludes part one of the book which deals with the General Principles of Collective Psychology.

Part two treats of 'The National Mind and Character'. The study of nationhood is essentially the work of group psychology. Nationhood is essentially a psychological conception, since mental organization resting on tradition is its most essential condition. Space does not permit of our following McDougall farther in his development of this part of his work. Part three is distinctly ecological in its treatment of the development of national mind and character, of the factors of national development, of the differentiation and crossing of races, of the influence of physical environment and the influence of occupations, with reference to the Le Play School. The final three chapters deal with racial changes during the historic period, with the progress of nations in their youth and the progress of nations in their maturity.

During the decade that has elapsed since the publication of this work by McDougall, the study of social psychology has made fairly rapid progress and it is all of the utmost interest to the student of human ecology. The study of such a work as the *Source Book for Social Psychology* by Kimball

Young (1928) shows how wide is the range covered. The first part of this work deals with the general features of social behaviour, e.g. the individual and society, evolution and prehuman social life, human social life, types of social groupings, group controls and culture standards, to give only the main chapter headings. Part two deals with the psychological foundations of social behaviour, part three with personality and social behaviour, part four with social attitudes and the subjective environment, part five with leadership and prestige in social behaviour, and part six with collective behaviour. The whole of the 800 odd pages are full of material having a very direct bearing on ecology. The author in his introduction lays special stress on his view that the social behaviour of individuals cannot be understood without some knowledge of the nature of the social life and of the culture patterns to which the individual is exposed. He believes that a more adequate approach to social psychology can be made through the group than through the individual.

With this the present chapter may be brought to an end. Our object has been to illustrate one very important line of approach to the subject of human ecology, though it is not the only one. If we have made the chapter read too much like a condensed history of psychology that has been done deliberately. If consideration of space had not made it impossible, still more detail should have been given, for ecology cannot afford to neglect any aspect of science which subserves the same general purpose as ecology itself, the explaining of man and his behaviour.

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## VI

# CONTROL OF THE ENVIRONMENT. MAN'S CULTURE

Definitions—The Science of Anthropology—The Classical or Evolutionary School of Anthropology—The Geographical and Diffusionist Schools—The Functional School—The Ecological Method in Anthropology—Cultural changes and Growth—Bibliography.

### DEFINITIONS

WE are now in a position to commence the study of man's more active relationships to his environment and his control over it. It has often been pointed out that the main difference between man and other animals is that the former uses tools. The use of tools began very early in his evolutionary history and, as a result, he has to a large extent overcome the necessity for changing his physical condition to meet new environmental conditions. His body has not altered very much since palaeolithic times. What has evolved since then are the tools he uses, and the results, as seen in this modern age of machines, are sufficiently impressive. The evolutionary history of man, therefore, is largely concerned, not with bodily changes as in the case of animals, but with what is known as man's 'Culture'. The term culture, however, requires very careful defining.

Pitt-Rivers (1927) points out that

'the general cultural level of a people is conditioned by three factors; by their heritage of *culture forms*, traditions, art forms, beliefs, customs, and social organization; together with *culture accessories*, implements, weapons, the products of art and mechanical discoveries; and by their *culture potential*, a term applied to their innate constructive ability, the capacity to develop, under suitable conditions, artistic, scientific or technical skill, and temperamental dispositions. Culture forms are not simply bequeathed to a people and in turn handed on by them intact, but are developed and modified by successive generations, while at every stage culture is conditioned by the capacity of people to give expression to it. Although culture form is conditioned by culture potential, the inheritance of the two may come from very different sources.'

A fuller general survey of the meaning and content of culture is given by Clark Wissler in his book *Man and Culture* (1923). It is worth our while to follow his analysis and note his detailed terminology at least up to a point, as follows.

(a) *Culture trait*. This is the unit of tribal culture. A tribal culture is characterized by the enumeration of its observable traits and the culture of one is distinguished from another by differences in these traits. Examples of culture traits are, procedure in kindling fire, custom of a man marrying his wife's sisters, &c. A culture is not to be comprehended until the list of its traits approaches completeness.

(b) *Culture complex*. The culture traits do not form isolated clear-cut units. They are associated in complexes, e.g. the use of wild rice among the Ojibway Indians is a culture trait, but it is part of a culture complex as well. Though the plant was wild, some care was given the plots where it grew; later the plants were tied in bunches to discourage rice-eating birds, then the rice was gathered, cured, hulled, winnowed, stored, cooked, and eaten. Some of it was exchanged, some given away. Intimately bound up with the whole are property rights, labour obligations, etiquette, methods of keeping time, and a number of special religious observances, prohibitions, tabus. The whole chain forms the 'Wild Rice Complex'. Other examples of 'Trait complexes' are head-hunting, totemism, couvade, tobacco, maize, wheat, dog-traction, the horse, the use of milk, the wheel, exogamy, sun-worship, and blood sacrifices.

(c) *Culture type*. The cultures of the world are classified according to their content. By type of culture is meant a norm, or standard form of tribal culture readily distinguishable from others.

(d) *Culture area*. The culture area defines the range of the Culture type.

(e) *Culture centre*. A true culture area is a succession of distribution zones encircling a nucleus, and this culture centre is the point of dispersal from which trait-complexes are diffused.

(f) *Adhesion of trait-complexes*. Trait-complexes tend to be associated or correlated in separate tribal cultures, e.g. Hobhouse, Wheeler, and Ginsberg found that polygamy

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traits show a maximum adhesion to pastoral traits as do human sacrifices to agriculture, infanticide to hunting, wife-lending to hunting, &c.

(g) *Culture Patterns*. All tribal culture has a plan or pattern into which the trait-complexes can be fitted. The following general outline will more or less fit them all.

1. *Speech*.  
Languages, writing systems, &c.
2. *Material traits*.  
Food habits, shelter, transportation and travel, dress, utensils and tools, &c. Weapons, occupations and industries.
3. *Art*.  
Carving, painting, drawing, music, &c.
4. *Mythology and Scientific Knowledge*.
5. *Religious Practices*.  
Ritualistic forms, Treatment of the sick, Treatment of the dead.
6. *Family and Social Systems*.  
Forms of marriage, Methods of reckoning relationship, Inheritance, Social control, Sports and games.
7. *Property*.  
Real and personal, Standards of value and exchange, Trade.
8. *Government*.  
Political forms, Judicial and legal procedures.
9. *War*.

The scheme of Wissler is comprehensive, though it only represents an outline which can be still further greatly elaborated. There is, however, so far as clearness is concerned, a distinct disadvantage in over-elaboration especially at the present stage of our discussion.

#### THE SCIENCE OF ANTHROPOLOGY

Anthropology is still a very young science though its progress in recent years has been relatively rapid. Like botany and zoology it has a morphological aspect, which is generally designated 'physical anthropology'. This deals with man's physical characteristics and the comparison of the different



racess of mankind from this standpoint. It is as important for the study of human ecology as the study of plant morphology and systematic botany is for plant ecology. Cultural anthropology or ethnology, on the other hand, deals with the general processes of the culture of different communities. Certain aspects of it have become very distinctly ecological, others are less so, depending on which term of the triad (environment—function—organism) is stressed. As in the case of most young and vigorously growing branches of science there has been during recent times a good deal of difference of opinion and occasionally acrimonious debating as to the relative importance of different lines of attack. There are different 'schools' of anthropology just as there are of psychology.

#### THE CLASSICAL OR EVOLUTIONARY SCHOOL OF ANTHROPOLOGY

First of all there is what may be described as the classical or evolutionary school of anthropology. Its origins go very far back. Men have always sought to explain how their customs and traditions originated and the mythology of all peoples are full of explanations. The Greeks and others of the ancient civilized world put on record much traditional but probably not very accurate 'history' of their cultural institutions, deriving them from the wisdom of their leaders and law-givers. In modern times the tendency has been to seek for origins among primitive peoples whose relationship to their environment is simpler than among civilized communities, whose separate outlooks or mental attitudes are regarded as having much in common, whose cultures, therefore, must also have much in common and may be regarded as the starting-point for other and more complex types. The beginnings of this classical or evolutionary school of anthropology may be found in the writings of English philosophers Hobbes and Locke, but Tylor is generally regarded as its founder. Frazer in his monumental work *The Golden Bough*, Westermarck, Briffault, and many others have added enormously to its literature.

This school regards culture as a natural growth obeying certain evolutionary laws and exhibiting certain character-

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istics which can be compared one with another much in the same way as the taxonomist compares the morphology of plants.

The evolutionary anthropologists study cultural successions in time and the influence of preceding stages on the succeeding. Among the higher cultures, half-forgotten customs are explained by comparison with more primitive cultural types. They accept the fact that similar or identical, though striking and unusual, culture traits or trait complexes, may occur in widely separated geographical areas as a perfectly natural thing, comparable in every way with the occurrence of very similar or identical plant forms in, say, American deserts and in African, or the origination of similar morphological structures in widely separated phylogenetic classes. At the same time, while mainly concerned with origins and development, this school of anthropology does not, as its rival 'diffusionist' school has often maintained, neglect the study of the spread of cultures, any more than the systematic botanist neglects the study of plant migrations. It is not, however, unfair to say that the evolutionary school does look at the biological triad from the organism end in exactly the same way as most botanists and zoologists regarded the study of plant and animal life during the latter half of the nineteenth century.

#### THE GEOGRAPHICAL AND DIFFUSIONIST SCHOOLS OF ANTHROPOLOGY

Just as the study of plant and animal geography grew up side by side with the study of the morphology, classification, and evolutionary history of plants and animals, so also the subject of human geography was contemporaneously built up especially from the eighties of last century onward. Here the subject is viewed from the environment end. F. Ratzel may be regarded as the founder of this school while Vidal de la Bache, through his work on the *Principes de Géographie Humaine*, has been one of the dominating influences. E. Semple, one of Ratzel's followers, did much to spread his ideas and Ellsworth Huntington is a modern leader of the school. Ratzel mapped out in great detail the distribution of the different types of 'culture accessories'

among the different peoples throughout the world as well as 'culture forms'. The modern attitude, as represented by Huntingdon, lays great emphasis on the human habitat and changes in it—particularly changes of climate which, acting through the process of natural selection, have profoundly modified the evolution of races and their culture. This has sometimes been regarded as pure human ecology, and in a sense this is true but, by tending rather to over-emphasize the importance of environment, it is apt to give a somewhat one-sided view. It is not sufficiently holistic. By this remark it is not intended to minimize in any way the extreme value of the contributions made by the school to the subject as a whole. It is difficult, if not impossible, to carry out research work in more than one field at a time. But inevitably, if the approach to the study of man is through the environment, there is a tendency to think of environment as being in control, whereas, as man's culture develops, it is often the other way round.

The diffusionist school of anthropology lays stress on archaeological or historical facts and hypotheses and the diffusion of culture, and tends to deny, except in a very general way, the possibility of independent origins of identical or similar culture traits or culture forms. This school, as already remarked, has not always been very fair in its attitude to the evolutionary school which does not in turn deny the possibility of diffusion. The diffusionists are distinctly in alliance with the purely geographical school, since diffusion cannot be studied without reference to geography and environment. In fact it was Ratzel who first postulated a common origin for similar culture forms. It was Graebner, however, (1905, 1911), who first systematized the study of diffusion as a result of his work on Melanesian, Australian, and Polynesian cultures. He believed that the cultures of those regions can be shown to be made up of several distinct cultural strata or types which have resulted from a number of successive historical invasions or migrations of peoples who differed from one another culturally and racially. This theory would explain the existing cultural conditions of peoples, in all parts of the world, as made up of about seven or eight world-wide successive migrations. Their point of

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origin is supposed to be somewhere in south-east Asia. Each migration is supposed to have carried with it, wherever it went, a distinct culture. Graebner's theories have been modified considerably by W. Schmidt, Frobenius, and others.

Among English anthropologists Dr. W. H. P. Rivers was the first to be impressed by the diffusionist standpoint which was pushed to an extreme by Elliot Smith and W. J. Perry. For the best exposition of this view-point Elliot Smith's article on 'Anthropology' in the 12th edition of the *Encyclopaedia Britannica* may be consulted, but the same is set forth at greater length in his *Human History* (1930). He regards the evolution of culture as more or less an historical growth. He adopts Perry's very useful name of 'Food-Gatherers' for the primitive types of nomad who have neither domesticated any animals, except the dog to assist in hunting, nor have begun to practise agriculture. The primitive food-gatherer, according to Elliot Smith, so long as he is free from the disturbing influence of civilization, is by nature a happy, well-behaved child, full of generous impulses and free from vice. Modern representatives of this class are survivors of the state that was common to all mankind before civilization was created about sixty centuries ago.

'In those times men were without houses and clothes, without social or political organisation, without property or any restraints upon their freedom other than such as common decency and consideration for other human beings imposed. Free from the common causes of exasperation, envy, malice, the innate goodness and kindness of man found unhampered opportunities for expression. Men were happy and peaceful, kind and considerate. In spite of the discomforts of daily life, men cheerfully enjoyed a state of Arcadian simplicity. It was indeed the Golden Age of which poets have been writing for thirty centuries, in spite of the contemptuous denials of cynics and philosophers that mankind was ever peaceful and contented.'

We shall be in a better position to judge whether Elliot Smith is right in his estimate of the character of primitive food-gatherers when we have dealt with their general ecology at a later stage. In any case it was Egypt, according to him, that was responsible for the change brought about by civilization, for it was there that civilization commenced. From



Egypt it has spread to every part of the world with, apparently, not altogether desirable results. The main importance of the contribution made by the diffusionist school of anthropology will probably ultimately be held to have been their insistence on applying methods of historical analysis wherever possible, in which respect they have accomplished a great deal.

In addition to the separate view-points of independent invention on the one hand, and diffusion on the other, to explain cultural similarities, Wissler (1923) and others add a third possibility, which is convergence.

'Since in all matters of invention one step leads to another, we may suspect that trait complexes evolve from simple beginnings. So it is conceived that, in the course of time, two or more quite different traits, originating in widely different cultures, may come to be similar. Even if separate invention is denied, convergence is still a possibility.' (Wissler, 1923.)

Boas and Goldenweiser have shown that convergence is not only possible but extremely likely, since the possibilities along any particular line are so limited that there is a high degree of probability that the same solution will often be duplicated.

The American anthropologists generally follow lines similar to those laid down by Wissler in the work already referred to. They have devoted much attention to the spread of trait complexes from culture centres through culture areas which, in the case of certain trait complexes, have often become almost world-wide. But they do not accept the view of the more extreme diffusionists like Elliot Smith, who deny the possibility of independent origin altogether. R. H. Lowie, who is to be classed rather with the functional anthropologists, remarks (1926):

'The pan-Egyptian view implies a complete passivity of all non-Egyptian peoples, yet many ingenious devices, current in ruder cultures and rooted in local conditions, disprove the corollary. Indeed, the irreversible flow of cultural elements from the more complex to the ruder cultures is refuted in history. The Caucasians borrowed maize and other cultivated plants from the American aborigines and B. Laufer's studies show that the Chinese repeatedly profited by contact with peoples of inferior level.'

## THE FUNCTIONAL SCHOOL OF ANTHROPOLOGY

Once more, as in the other human sciences, there are among anthropologists many who believe that the most fruitful line of attack is to concentrate on the middle term of the environment—function—organism triad. The ecologist has little fault to find with this attitude provided that the other two terms, environment and organism, are not neglected. The functional aspects of anthropology are many and varied. There is much of social psychology which is essentially identical with functional anthropology and anthropologists have made many contributions to the psychology of primitive peoples. In addition there is a large literature dealing with comparative religion, comparative jurisprudence, comparative technology, art, architecture, &c., all of which has a more or less direct bearing on man's cultural relationship to his environment. Among earlier works F. Boas wrote on the *Mind of Primitive Man* (1911), and the views of Lévy-Bruhl (1910, 1922), who sought to demonstrate that primitive peoples have a 'pre-logical' mentality, have been much discussed and generally combated. A recent work by Raoul Allier on the *Mind of the Savage* (1929) shows more fairly how primitive mentality differs from that of higher cultural types.

He does not go so far as Lévy Bruhl, but he thinks that it is belief in magic which is the basis of primitive mentality, which moulds it and dominates it. Though the extreme views of Lévy Bruhl have not been accepted, he is generally credited with having made a valuable contribution to science in forcing this aspect of their subject on the attention of anthropologists. The general opinion of authorities, at present, seems to be that any difference in mentality between primitive man and cultural man are differences in degree rather than in kind. Even magic beliefs and superstitions are by no means confined to savage peoples. Moreover, the idea that primitive man never thinks of himself as an individual but only as a member of the tribe or group, a view also held by Lévy-Bruhl as well as many others, has been definitely disproved by the work of Boas, Marett, Schmidt, Lowie, Malinowski, and others. A still more recent work by

Porteus (1931) on *The Psychology of a Primitive People* will be dealt with in more detail when the people concerned, the Australian aborigines are being considered. Being an experimental study it is of fundamental importance in many respects in this connexion.

Attempts have been made by the psycho-analysts, including Freud himself, to interpret the facts of anthropology and culture in terms of their peculiar psychology, but not always very successfully. Malinowski, however, has opened up some promising lines of research in this field. He has shown in his book on *Sex and Repression in Savage Society* how the development of pre-sexual life differs in Europe and Melanesia and how also, at the next stage of sexuality

'in Europe, there is a latency period more or less pronounced, which implies a breach of continuity in the sexual development and, according to Freud, serves to reinforce many of our repressions and the general amnesia and to create many dangers in the normal development of sex. On the other hand, it also represents the triumph of other cultural and social interests over sexuality. Among the savages at this stage, sex in an early genital form—a form almost unknown among ourselves—establishes itself foremost in the child's interests, never to be dislodged again. This, while in many respects it is culturally destructive, helps the gradual and harmonious weaning of the child from the family influences.'

The functional school of anthropologists, to which B. Malinowski, Radcliffe Brown, G. H. Lane-Fox Pitt-Rivers, Mrs. Hoernlé, R. H. Lowie, R. Thurnwald, Dr. Hortense Powdermaker, Dr. Margaret Mead, Dr. R. F. Fortune, Dr. Audrey Richards, and others belong, aims 'at the explanation of anthropological facts at all levels of development by their function, by the part which they play within the integral system of culture, by the manner in which they are related to each other within the system, and by the manner in which this system is related to the physical surroundings'.<sup>1</sup> This school insists on the necessity for field work in anthropology, in which respect they also agree with ecologists.

We shall have a good deal more to say regarding func-

<sup>1</sup> See B. Malinowski in the article on 'Anthropology' in the 13th edition of the *Encyclopaedia Britannica*, which is the best presentation of this functional and essentially ecological outlook on anthropology.

tional anthropology at a later stage, but in this place a short reference may be made to one of the most recent contributions by a member of the school, in the book by Dr. Audrey Richards on *Hunger and Work in a Savage Tribe* (1932). This work is, in some respects, the most ecological of all recent anthropological studies, since the culture and social organization of the Southern Bantu peoples of Africa, with which it deals, are shown to depend in a most fundamental way on their food relations and nutritive processes. Not only so, but Dr. Richards presents in this book one of the most readable accounts of man's autecology that has so far been attempted. She divides the life-history of the Bantu into the following stages; (1) infancy or suckling period where the child is entirely dependent on the mother, (2) weaning period where separation begins and the child experiences, for the first time, the whole phenomena of *tabu*, (3) early childhood (the period from three years of age till about seven or eight), when the first economic tasks are begun, (4) later childhood (up to the attainment of puberty) where there is a division of children according to sex, involving altered occupations and the beginnings of economic activities proper, (5) adolescence, with initiation rites, where the rights and obligations of the individual as related to the tribe acquire a new significance.

Probably more and more attention will in future be paid to such human autecological studies. The experience of plant ecologists shows that they are absolutely of fundamental importance. They should not, of course, stop short at the stage of adolescence. Youth, middle life, and old age are equally important. W. D. Hambly (1926) in his *Origins of Education among Primitive Peoples* has given a very useful summary of the information available on this subject in the literature of anthropology. He finds that 'everywhere among primitive races there is the nucleus of a sound development in handicraft, morality, and social obligation' and 'the so-called backward races have proved themselves to be educationists, teachers, psychologists, and disciplinarians of no mean order'. He deals with such subjects as maternity and child welfare, the utilitarian value of play, preparation of boys and girls for adult life, recognition and utilization of



special ability, and the formative value of moral stories, religious ideas, and disciplinary object lessons. 'Savage races', he says, 'have a system of training which imparts an understanding of the nature of social duty, while in no less degree does it show the reciprocal relationship between the unit and the group.'

#### THE ECOLOGICAL METHOD IN ANTHROPOLOGY

The ecological method of approach to the study of man's culture should have already been made apparent by what has been said. It insists on continuing to treat the environment—function—organism triad in a holistic manner. It has no quarrel with any of the separate schools of anthropology but finds them all useful. It has no bias whatsoever and is content to attack the problem from any angle, yet it believes very strongly in order and method, and endeavours to avoid all distorted or narrow views. It fully realizes the value of intimate analyses but, at the same time, it likes to stand back at frequent intervals and view the problem as a whole.

The environment in all cases should be very carefully analysed and all its aspects, physical, biological, and sociological, recorded and assigned their proper values. The complex interaction of the different environmental factors should be noted and while avoiding the error of assigning effects to single 'causes', at the same time, the useful concept of 'limiting factors' should be made full use of. Anthropology can undoubtedly gain and, to some extent, has already gained a great deal from adopting the methods of field ecology.

With the outlook of the functional anthropologists as already remarked, ecology is more or less in agreement and heartily supports their insistence on the importance of field studies. It does not, however, support any of the avowed neglect on the part of some of them of the study of cultural evolutions. It is almost impossible to avoid questions of evolution, and no anthropologist, as a matter of practice, does neglect them. Even when the work on evolutionary history has been carried out by the comparative method in the museum or in the study, it has proved valuable, and ecology fully realizes this, just as it realizes the value of studies of cultural diffusion.

The synecological analysis of different types of human communities has already made considerable progress. Some of the earlier work was faulty through the lack of a reliable technique on the part of observers. Ignorance of the language spoken by the peoples concerned makes the recording or interpreting of ecological facts all but impossible. Moreover, as Malinowski and others have pointed out, the very necessary distinction between direct observation and native statements and interpretations, on the one hand, and the inferences of the anthropologist on the other, has not always been clearly drawn. In recent years, however, the number of accurate descriptive works on human synecology has been fairly rapidly increasing.

The importance of the autecological method has already been repeatedly emphasized, and that too is being developed in human ecology. Van Gennep in his *Rites de Passage* demonstrated its importance in connexion with primitive religion. The work by Dr. Richards has already been referred to, and others (e.g. Miss Margaret Mead in her books *Coming of Age in Samoa* (1929) and *Growing up in New Guinea* (1931) and Dr. Hortense Powdermaker in *Life in Lesu* (1933)) have made valuable contributions to this section of the subject. It is very important to investigate as fully as possible the responses of the individual to his environment at all stages in his life-history. Only in that way can the intricacy of social organization be fully understood. Not only so, but there is always some degree of truth in the dictum that 'ontogeny repeats phylogeny' and the theory, originally elaborated by Stanley Hall, that the order in which the individual acquires a knowledge of culture forms is, in a very general way, the order in which that particular tribal culture evolved is also probably not entirely erroneous. Primitive cultural traits may linger on among the children of a people when those traits play very little part or are entirely forgotten among the adults. The study of children's games is important from this standpoint. Not only can organized games be traced back to primitive tribal customs, but the play-time occupations and behaviour of children, e.g. constructing tents, building shelters, exploring caves, collecting birds' eggs, and countless other acts, are all sug-

gestive of earlier stages of racial cultural development. On the mental side the same thing is illustrated by the attitude of children towards 'fairy tales'—as compared with that of savage peoples towards their mythology and folk-tales.

The extraordinary success of the Boy Scout and Girl Guide movements has undoubtedly been due to the ingenious way in which they have taken into account the need for a more primitive culture pattern in dealing with boys and girls.

Among civilized races attention to the study of this ontological principle has brought to light many interesting facts, but it is still more important when applied to more primitive peoples. The existing works tend to devote attention chiefly to the child in relation to the present-day life of each community, its treatment, upbringing, and general education (see, e.g., N. Miller, 1928). But scattered through the literature of anthropology there are references which show that, while the adult life of a people may have advanced culturally to a fairly complex stage of agriculture and village life, the boys and girls are allowed to live the life of the more primitive food-gatherers to a greater or less extent. A quotation from Junod (1912) will help to illustrate this point.

'This life in the veld, always in the midst of Nature, develops the power of observation amongst boys. They know everything in the bush; the big Psyche caterpillar (*Eumeta cervina*) which hangs from the nembe-nembe shrub (*Cassia petersiana*) like a bundle of little sticks and which they call *Mahambanindlwane*, "the one which walks with his house"; the big carabid beetle, which appears with the first rain, the *Anthia alveolata* marked with large hollows on the elytra and which is therefore named "the son of the small pox" and so on. . . .'

'Of course they particularly appreciate things edible, especially the *shitambela*, a big Bupresta beetle which they roast and suck.' . . .

'Hunger always keeps company with these boys who do not find enough to eat at home. Truly they ate to their hearts' content (shura) yesterday evening, but this morning they had only a scanty breakfast (fihluta). They try to satisfy their never satisfied appetite by catching game; not big game, of course, as they have no real weapons, but birds, field mice, eggs in the nest (the less fresh they are, the better, because there is more meat inside!), &c. To get birds they throw sticks at them and are very clever at killing a partridge rising heavily from the grass; or they make traps with a flexible stick to which they tie a string with

a bait. On the borders of the lake of Rikatla, boys used to catch even big birds with these traps. 'They lay many kinds of snares.'

Miller (loc. cit., p. 150) refers to other examples.

'Among many American Indians, although bows and arrows have been discarded for guns long since, the boys still use blunt-pointed arrows for killing small game. In the Patagonian regions of South America, the children still play with the *boleadora*, or sling, which is an evident survival from the days when these tribes, the Chorotis and Ashluslays, used them as weapons on the pampas or plains for which alone they are suited. In Java, likewise, many of the games played by the children show unmistakable signs of antiquity, pages out of the culture history of the folk.'

#### CULTURAL CHANGES AND GROWTH

Any change in culture potential must involve deep-seated changes in man's heritable qualities. The modern study of genetics as applied to man seeks to throw light on this important question, though it must be confessed that the laws of heredity have not yet determined how 'genius' amongst men arises. As regards changes in culture forms, it is interesting to find that Hobhouse (1924), in seeking to explain how custom originates, has recourse to the example of children.

'How does custom originate?' he asks. 'We can best understand that by considering how it changes. Without repudiating custom, men seek their own ends under its aegis as best they can. They squeeze it a little this way or a little that. They "try it on" and, if the experiment is not resented, it becomes a precedent. The process begins in the nursery. The small child begs to sit up an extra ten minutes on a special occasion. Next evening the unsuspecting parent finds that the privilege has become a precedent. So it is probably with origins. In any new situation a man of initiative acts as suits his wishes there and then. If his action is not opposed he repeats it. It is an example for others and, in a short time, it is "what has always been done". Custom is something to which people have adapted themselves, a basis on which life can be carried on, and this is the real ground of its authority.'

'Law arises out of custom, but is essentially a rule declared and enforced by a constituted authority.'

Changes in culture forms are studied scientifically mainly by using the comparative method as applied to different cultural stages or by the help of traditional or written history.



The study of the growth and evolutionary development of cultural accessories (tools, weapons, products of art, mechanical contrivances, &c.) is more straightforward. This is the main business of the archaeologist, and historian.

The history of culture accessories is a record of man's inventiveness—from the days when he first used a sharp-edged stone to prize open a shell-fish or dig up some roots, till he invented the spear and the bow and arrow, till he succeeded in entering into a partnership with the dog, and he tamed the pig, the ox, the sheep, the goat, the ass, and other animals, till he (or possibly one of his more intelligent women-folk) first cultivated the barley and other crops, and after that invented hundreds and thousands of different utensils and weapons and new tools, till finally the race produced a Faraday or an Edison.

Invention is a creative process, but it is here that the relationship between environment and culture is most manifest and that responses are most definite, much more so than where culture forms are concerned. As Wissler remarks, 'The experience of the world is that, while a savage will throw away a stone knife and substitute a steel one after the first trial, he will be very slow to change a religious practice and especially a social custom.' The environment supplies the materials necessary for the inventions. Man builds a house of the material available, a framework hut covered with grass in the tropics of Africa, a stone hut in Europe, a birch-bark tent in North America, a snow-house in the Arctic regions. The relationship between environment and type of dwelling has been followed out in great detail by writers on human geography, e.g. Brunhes (1920).

It does not, of course, follow that because the materials are available a particular invention will result. Moreover, as Wissler has also insisted, an invention only becomes a cultural trait when taken up by many individuals. 'While an invention must work to survive, there is no guarantee that it will be given a fair trial and be allowed to stand according to its deserts.'

Many new ideas are still-born because they emerge before people are prepared to adopt them and fit them into their culture patterns. If the fitting of them involves a change in

social customs or in mode of life, the process is a slow one. Just as in our most highly civilized life of to-day, the owner of a horse-carriage has often been extremely loth to abandon his customary mode of travel and take up the motor-car—even after its general superiority had been definitely established—so, no doubt, throughout the history of cultural development innovations were accepted slowly or, sometimes, in spite of their usefulness, not at all. It depends largely on whether any particular invention is sufficiently related to established practice, though it depends on other things as well. Changes of culture form (customs, social organization, &c.) are therefore intimately bound up with culture accessories. A good deal of the muddle which appears to characterize the civilized world to-day may be due to the fact that our culture forms (our laws and customs, our institutions generally) have not altered to keep pace with our culture accessories.

We are slow to change our customs, much slower than we are to change our tools. At the same time it is remarkable how persistent most ancient types of culture accessory have been. For instance, the most primitive type of wooden plough, or something very like it, is still in use. So is the bow and arrow, the canoe, sandals, snowshoes, the hoe, the axe, &c. We pride ourselves on improvements in agriculture, but for the most part our cereals and other economic plants are those that have been in use since the very remote past. No new domestic animals, worth mentioning, have been tamed and made use of in modern times. It is well to remember such facts when we contemplate our railways and motor-cars and aeroplanes, the wonders of electricity, the production of newspapers and books by the million, the marvels of wireless communication and all the other culture accessories of modern man. To the anthropologist the world is all the more interesting because so much of its ancient culture has persisted, though there can be no doubt that the modern tendency is for a levelling and standardization of culture over the whole world. This is an inevitable result of the remarkable increase in the rapidity of communication. There is all the greater need for a science of human ecology, not only to analyse the facts as we see them to-day, but

to help mankind so to arrange things, that its wonderful cultural heritage is preserved and added to until it reaches still higher levels.

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## VII

### ANCIENT MAN AND HIS ECOLOGY

Introductory—Fossil Remains of Man—Environmental Conditions and Changes—General Responses to the Environment—Control of the Environment and the Cultural Succession—Palaeolithic—Mesolithic—Neolithic—The Ancient Civilization of Asia and the Near East—Bibliography.

#### INTRODUCTORY

THE whole history of the evolution of life in the world, as revealed by the fossil record, has an important bearing on ecology. As each of the great phyla of plants and animals, through vast periods of time, from lowly beginnings, reached its evolutionary climax, it succeeded more and more in perfecting its responses to its environment. Change of environment, not necessarily only physical environment or climate, but also the living environment, e.g. the rise of other forms of living organisms, has usually been the apparent cause of the decadence or dying out of life-forms. During pre-Devonian times when life was mostly confined to the sea—a relatively uniform environment—the changes that went on were probably largely to be correlated with changes in the living environment. One of the greatest of all evolutionary triumphs was the invasion of dry land surfaces by more and more complex types of living organisms, though bacteria and similar extremely simple forms very likely inhabited dry land from the commencement. Space limitations prevent us from any lengthy discussion of general ecological evolution, but among animals the breathing of air instead of water, the changing of limbs to assist in walking, climbing, or flying instead of swimming, the postponement of the time of separation between mothers and their offspring, and other similar general trends are all ecologically of the utmost importance. Each of them made it possible for living organisms to conquer more and more of their environment.

Man's evolutionary history must be viewed from the same standpoint. To begin with, his environment, so to speak, forced his reactions to it. His responses were relatively passive. He took what he could get and he lived as

he was compelled to live. His choice was very limited. He was able to modify his living environment to some extent as all plants and other animals do, but his power of changing his inorganic environment was slight. The earlier stages of his development both physically and culturally were very slow, but, since his culture could be handed on from generation to generation with a cumulative effect, his cultural development has in recent times appeared to be very rapid. The study of archaeology has made great progress during the last half century and the facts established are of the greatest possible assistance to the student of human ecology, though to give any adequate summary of them in a short chapter is no easy task. The same applies to physical anthropology and particularly to the comparative anatomy of the different types of early man and his nearest relatives.

#### FOSSIL REMAINS OF MAN

It is hardly necessary to do more than refer to types like *Australopithecus*, an extinct cousin of the chimpanzee and gorilla, but with a larger brain, to whom the Taungs skull, discovered in South Africa, belonged. Though more ape than man this creature had sufficiently advanced in intelligence, according to Dr. Broom, to overcome the baboon, antelopes, and a variety of other animals, and after killing them break their skulls to obtain the brains and their bones to get the marrow. These facts are deduced from the remains found in the kitchen middens associated with the skull. Another primitive ape-man, the *Pithecanthropus erectus* of Java, had a brain much bigger than that of a chimpanzee but only half the average size of our own. It has been thought, from the study of his skull that the parts of the brain which control speech had developed sufficiently to allow us to assume that the Java man had learned to speak. He had powers also of visual discrimination far beyond those of the apes and monkeys. His progress in those directions is to be correlated with the fact that, as his name (*P. erectus*) implies, he could walk more or less upright, though not so erect as we do, for his leg bones were not quite straight. Since he could walk on his hind legs his hands were free and he could use them for purposes no other animal could attempt.

Whether he used stones, pointed sticks, or clubs to assist his hands in the work he undertook, we cannot know for certain, but it is fairly safe to assume that he did so. Yet his primitive brain could hardly have enabled him to shape them into tools or weapons. Another ancient genus of mankind is represented by *Sinanthropus* or 'Peking man' whose skull, discovered in China a few years ago, shows that he was slightly higher in the scale than the Java man, having a slightly bigger brain, and with closer affinities to the genus *Homo*. According to Abbé Breuil he used fire. Two other examples of early Pleistocene humanity have been found widely separated geographically from the others, viz. the *Eoanthropus* in England (the famous Piltdown skull) and *Palaeoanthropus* in Germany, the 'Heidelberg Man'.

Modern races belong to the genus *Homo*, and to the species *Homo sapiens*. A more primitive species, long since extinct, was 'Neanderthal man' (*Homo Neanderthalensis*). This species of human being whose culture will be dealt with later, had certain structural specializations which exclude him from being considered the ancestor of modern man, with whom he may, according to some, have been contemporaneous. He was of a distinctly uncouth type, with a large, flattened head, enormous brow ridges, a coarse face, big eye sockets, receding forehead, long upper lip, projecting jaw, receding chin, long arms, coarse, clumsy hands, and curved thighs. The trunk of the body was short and thick, the shoulders broad and stooping, the neck very thick, with the head projecting forward. His brain was large, as large as ours though probably not so finely organized.

Though the Neanderthals of Europe cannot have given rise to the Cro-magnon or other types of *Homo sapiens* which replaced them there or to any other modern types, the same may possibly not apply to Rhodesian man (*H. Rhodesiensis*) discovered at Broken Hill, who resembled the Neanderthals in general appearance. According to Sir Arthur Keith this skull, in point of size and lack of structural specialization, may serve to indicate a possible starting-point from which the large-brained Boskop type of early South African (*Homo sapiens*) may have been derived. Whether this is so or not, there formerly existed in South Africa large-brained types

of early *Homo sapiens*. Springbok man was apparently a contemporary of Boskop man, and in East Africa Oldoway Man and Elementeita man were of a similar type. They are regarded by Keith as proto-Hamites. While the Boskop and Springbok men were tall and large skulled, Fishhoek man, who came later, and, according to Keith was descended from the Boskop type, was smaller and had a smaller brain capacity, like the modern Bushman. Evolution has not always meant progress as far as brain capacity is concerned.

While the ancestry of the Bushmen and other modern African races is thus slowly being elucidated, the interesting discovery of the fossil remains of two individuals—a man and a woman—at Wadjak in Java, throws light upon the ancestry of the Australian and Tasmanian aborigines. Prof. Dubois is of the opinion that Wadjak man represents a Proto-Australian type. The recently discovered skulls of *Homo* (*Javanthropus*) *soloensis* he considers to be of the same race. In Australia itself a prehistoric skull has been found of a lad of about fifteen years of age at Talgai, and a fully adult skull together with four other fossilized skeletons at Cohuna, all of a proto-Australian type out of which, according to Keith, the modern aboriginal type has been evolved.

Since 1868, when five human skeletons were unearthed at Cro-magnon, in France, and were found to belong to the modern Caucasian race, from which all Europeans are descended, the attention of anthropologists has been directed largely to attempts to trace their earlier history. In recent years, Keith and others have looked to Asia as the likeliest point of origin for them. Researches by Miss Dorothy Garrod and Mr. Theodore McCown in Palestine have been fruitful of results, showing that Palestine, like Europe, was occupied for a long time by a Neanderthal-like race which was again followed by modern types, but this does not help to solve the problem.

In 1925, in the very heart of London, between Leadenhall Street and Lime Street, during excavations, a woman's skull was discovered by W. R. Dawson to which the name *Homo Londinensis* has been given. Keith finds a distinct relationship between this type and the earlier Piltdown type. In his 1931 work, he says that it is possible that Piltdown man



represents the ancestor of the modern type of man, 'The London skull cannot be assigned to the Neanderthal stock or stem; its anatomical characters are those seen in the skulls of Piltdown and modern types of humanity, but its nearest affinity is to the Piltdown type.'

The work of Dr. L. S. B. Leakey, during the last few years, has served to focus attention on Africa as the possible cradle of modern mankind. In East Africa the whole of the Pleistocene period is represented by deposits showing alternating wet and dry intervals corresponding to the alternating cold and warm periods of Europe. The deposits are remarkably complete, representing a record of the history of the last million years according to some geologists, though others prefer a somewhat shorter estimate. That man of one type or another existed in East Africa at the very beginning of the Pleistocene is proved by the presence of his stone implements, and fragments of the lower mandible of a primitive type of man have been discovered by Leakey in the deepest and oldest deposits at Kanam, and named *Homo Kanamensis*. This jaw, according to Leakey, in its chin region, shows a stage in the evolution of modern man. In middle Pleistocene deposits at Kanjera, Leakey found a portion of a femur and two skull caps which he has described as primitive generalized examples of true *Homo sapiens*. He is, therefore, of the opinion that *Homo sapiens* existed in East Africa long before he appeared in Europe, that he even pre-dated the Neanderthals of Europe and was contemporaneous not only with Rhodesian man but also with Peking and Piltdown man. If this view is correct, the old idea that *Homo sapiens* has descended from one of the more primitive genera mentioned above must, of course, be abandoned. He is only remotely related to those structurally more primitive types, which were his contemporaries. He goes back to the beginning of the Pleistocene and his ancestors must be searched for in the Pliocene.

The earliest type of stone implements used by man (the Chellean culture) is very widespread from England over western Europe to India and southward to South Africa. The fact that his earliest remains should have been searched for and discovered in Kenya, East Africa, near the centre of

that vast area is, according to Dr. Leakey, a very significant fact. In a recent popular article (published in *John o'London's Weekly*) Keith says:

'I admit very willingly on the evidence discovered by Dr. Leakey in East Africa and by others in Rhodesia and in South Africa, that there is much to be said in favour of placing in Equatorial Africa the Garden of Eden, wherein the ancestral type of modern humanity came into being. And yet I am most reluctant to accept an African origin for the white or for the yellow races of mankind. I find it difficult to believe that the continent which has given rise to races so specialized as the Negro and Bushman could have produced the Caucasian and Mongolian forms of humanity. Facts are coming to light, as we extend our search for the fossil remains of ancient man in Asia and Australia, which raise doubts in our minds as to the mode in which modern mankind became differentiated into races. It is becoming possible to believe that these races have arisen, not from a single ancestral type which spread abroad from a single centre differentiating as it spread, but came into being by a process of what is called "parallel evolution".'

#### ENVIRONMENTAL CONDITIONS AND CHANGES

The most important facts regarding ancient man himself having been summarized in the briefest possible way, we may now equally briefly turn our attention to the first term of our triad—the environment. General Smuts in a lecture delivered at the Durban meeting of the South African Association for the Advancement of Science in 1932, gave a very clear summary and correlation of the probable course of the main climatic changes throughout the Pleistocene in Europe and in Africa. For our present purpose this may be still further condensed.

1. At the close of the Pliocene there were great earth movements and volcanic activity, and the climates of the world were getting colder in the northern hemisphere.

2. The Günz glacial period at the beginning of the Pleistocene was followed by a short, wet, interglacial period and then by the Mindel glacial period, the whole corresponding to the Kamassian pluvial period in East Africa and the first pluvial period in South Africa. Piltdown man belongs to this first interglacial period and the culture was pre-Chellean or Chellean in Europe and Stellenbosch in South Africa.

3. Following the Mindel glacial period there was a second

interglacial period, very long, arid, and volcanic in Europe, corresponding to a desert (Kalahari) period in South Africa and an arid volcanic period in East Africa. Heidelberg man belongs to this period.

4. Next comes the Riss glacial period, followed by a short, wet, interglacial period with warm climate (the period of Acheulean culture) and then by the Würm glacial, all of it corresponding to the Gamblian pluvial period in East Africa (which was interrupted in the middle by a period of decreased rainfall) and also corresponding to the second pluvial period in South Africa. The Würm glacial period had a short interval in the middle and saw the dominance of Neanderthal man in Europe with his Mousterian culture. In South Africa the second pluvial period began with Fauresmith type of culture and ended with the Stillbay. Rhodesian man followed by the Boskop and Springbok types and finally by the Fishhoek man (Stillbay) all belong to this period. The time intervals for each of the preceding periods are largely a matter of guesswork since authorities differ so widely in their estimates, but from the close of the Würm glacial period onward the estimates are much more accurate.

5. In Europe the Achen oscillation lasted from about 13,500 B.C. to 9,500 B.C. This corresponded to a very dry period in East and South Africa. This was the period of Cro-magnon and Grimaldi Man in Europe and of the Aurignacian and early Capsian cultures, but in South and East Africa man has left no record during this time.

6. From 9,500 B.C. to 6,000 B.C. the climate of Europe became colder again, bringing the final phase of the last ice age known as the 'Bühl minor advances'. In East Africa this corresponded to the Makalian post pluvial period and in South Africa to the first post-pluvial period with its Smithfield and Wilton cultures. In Europe it is the period of Solutrean and Magdalenian cultures and of Predmost Cro-magnon and Chancelade man. This marks the close of the Palaeolithic period in Europe.

7. From 6,500 B.C. onward the climate of Europe changed from arctic to sub-boreal and cold temperate and finally to the present-day type. In East Africa a dry period lasted from 6,500 B.C. to about 1,000 B.C. when the Nakuran post-pluvial

period began. South Africa also had a rather prolonged dry period followed by a second post-pluvial period which apparently has been followed by a period of very slowly decreasing rainfall until the present day.

#### GENERAL RESPONSES TO THE ENVIRONMENT

The succession of climatic changes throughout the Pleistocene, as outlined above, affected all forms of life, both plant and animal, and their effects on man were not only direct but also, and even mainly, indirect through his relationships to his living environment. During cold periods he lived as a hunter of the larger types of animals, while, during warm periods, forests advanced, and his mode of life must consequently have greatly altered. There must have been many migrations, especially during the arid periods. At various times man apparently settled near inland sheets of water or along the sea-shore, where he probably lived largely on fish or shell-fish.

It is very difficult to deduce much with regard to his general functional responses. Archaeology is mainly concerned with his culture accessories, but it is permissible to argue that man must have devised some means of protection against his more important enemies. Apart from his remarkable brain he is, bodily, peculiarly defenceless against the attacks of the larger carnivora. He does not possess the strength of the gorilla or the agility of the monkeys. He can hardly have devised (all at once) effective weapons to make up for his lack of strength, and it is clear from his bodily structure that he did not, like the monkeys, specialize in climbing trees, though no doubt he may sometimes have taken refuge there. He doubtless often lived in caves, and once he had discovered the uses of fire he had an additional valuable method of defence.

Previous to this stage, however, after he had left the forest habitats and abandoned the habits of life of his cousins the apes, it is the opinion of Professor Cherry (1920) that man took refuge along the sea-shore, a habitat to which he has often returned and continues, up to the present day, to find peculiarly attractive. Here, from the beginning, he had comparative safety, for carnivorous animals track their prey by



scent, and the scent vanishes as soon as the wet sands or gravels of the shore are reached. It is true that monkeys (e.g. the crab-eating Macaque of Malaya) sometimes live on the sea-shore, and Scott-Elliot (1915) mentions that the monkeys of Sierra Leone sometimes visit the shore and eat oysters, but no other mammals ever seem to descend between the tide-marks. Cherry supposes that this is because of the absence of scent and movement in shell-fish. The recognition of food on the sea-shore demands, on the whole, a fairly high degree of intelligence but, once recognized, it is comparatively abundant. As shell-fish cannot run away, there was no need for man to develop special means of attack or defence. The brain alone became the organ of survival value. The sands are clean, soft, and free from insects, so man did not develop callosities, nor did he become immune to insect-borne diseases in the way lemurs and monkeys have become. Proto-man may have cracked shells with a stone instead of using his teeth. Sea-shore food is rich in nitrogen and phosphorus, soft and nutritious, and requires little mastication. Man's third molar is decadent; human babies can digest oysters, but not bananas, coco-nuts, or cereals. All these, according to Cherry, are facts, and there may be a causal relationship between them.

Life on the sea-shore and constant wetting would also in the course of time lead to a loss of hair, since hair under those conditions is a disadvantage. A naked animal dries more quickly and loses less heat than a hairy animal. Lowering of the body temperature makes an animal more liable to diseases, especially lung diseases, to which the primates are very subject; hence the survival value of nakedness in a sea-shore habitat.

A very long period at the sea-side, during man's evolutionary history, is the best explanation of the accentuation of the monthly cycle in woman and fortnightly rhythms. The alternation of 'spring' and 'neap' tides give periods when food would be abundant and periods when it would be relatively very scarce. Many varieties of shell-fish can only be found during 'spring' tides. Turtles lay their eggs by moonlight and these may have increased the lunar feastings.

For further details regarding anatomical evidence in favour

of his theory, Cherry's original paper should be consulted (*Science Progress*, vol. xv, 1920, pp. 74-100). Though there is much that is interesting and attractive in this theory, it remains perhaps too speculative to be generally accepted, and apparently it has not been taken much notice of by students of anthropology. Other environmental responses of ancient man are deduced largely from what we know of the behaviour of primitive, living races of to-day. It is assumed, though the assumption is not always entirely warranted, that the palaeolithic hunters were similar to those at the hunting stage of development at the present time, and Sollas has written a very fascinating book on *Ancient Hunters and their Modern Representatives* (1924). Since we shall deal with modern hunters in their proper place, it is hardly necessary to discuss, at the present stage, which of their characteristics were probably shared by ancient man, but one or two further speculations require brief reference. Carveth Read (1920) has put forward in his work on the *Origin of Man* the hypothesis that man was differentiated from the anthropoid stock by becoming a hunter, perhaps as early as the Oligocene period. If reliance is to be placed on the characteristics of the teeth of the Neanderthals and still earlier types, palaeolithic man was, to begin with, more of a vegetarian than a flesh eater. The evidence, however, of the stone implements he has left behind as well as the bones of animals associated with them and with his own fossil remains, is sufficient to show that man very early became a hunter and fisherman, though no doubt he continued, as modern hunting races do, to supplement his diet with fruits, seeds, tubers, bulbs, roots, and anything else he found edible.

The general influence of climate and climatic changes on the ecology of ancient man probably led to the following series of results. To begin with, wherever he originated, man must have found a sufficient food supply at all times of the year. The tropical or sub-tropical regions are best suited to provide for this requirement, and man's nearest relatives, the anthropoid apes, are, to this day, tropical or sub-tropical. Man could also find food, in plenty, along the sea-shore and the shores of lakes, and in all places where game animals, fish, or wild fowl abound, e.g. marshy places. Any change in

climate or in the living environment on which he depended, provided it was not of too sudden or drastic a nature, would lead in the end to distinctly increased intelligence, as well as an increase in his heritage of acquired culture. Climatic conditions that are uniformly favourable and unchanging would tend to cultural stagnation. The less progressive types of mankind would always prefer to remain in the more favourable climatic regions, and the more progressive types would invent means of overcoming harsher types of environment.

Climatic differentiation, therefore, in the long run, has probably led to a differentiation of types of man, in much the same way as among plants and animals, and the student of human ecology has much of value to learn from the study of general ecology as regards the effects of geographical isolation, migrations, &c. We may suppose that the more primitive, less progressive types always tended to remain behind and continue to live under the conditions to which they were accustomed, where they could obtain their food most easily. They made no attempt to change things. The more progressive types, in the course of time, invented one thing after another to help them to survive by modifying their environment; they learned how to keep warm by using the furs and skins of animals, they invented methods of dressing the skins and implements for doing so, they improved their hunting methods, and they took a big step forward when they learned the uses of fire. At the same time, doubtless, their social organization slowly evolved towards greater and greater efficiency, though the facts bearing on this complex problem are still somewhat meagre.

Differentiation among mankind in response to increasing environmental differentiation made possible further progress by the crossing of different types. To begin with, they may not have differed very much, but, as was shown in Chapter III, without crossing, peoples, like plants, have a very narrow range of variability, and consequently there is little chance of improvement, since good new types do not arise. In the course of time differences doubtless became more extreme and, owing to the possibilities of complete isolation for long periods of time in a sparsely inhabited world, they became more and more emphasized. We cannot be certain that there

was much mixing of widely different racial types until comparatively late in the course of man's evolutionary development, but the diversity of races existing to-day can best be explained as the result of initial crossings.

While climatic changes taking place slowly, and not in the end becoming too severe, lead to progress, on the other hand, too harsh an environment apparently leads first of all to degeneration and finally to extinction of races.

As the climate of the regions he inhabited became progressively colder, Neanderthal man at first showed himself thoroughly able to cope with it, and in doing so he became more and more efficient up to a point. When it became still more severe, however, he showed signs of deteriorating. In several cases his fossil remains show clear signs that he suffered from diseases, such as arthritis, that are favoured by the cold damp conditions of his cave-life. Whether he ultimately succumbed to diseases, or whether he was killed out by stronger, more disease-resisting, as well as more intelligent, types must remain at present unsolved questions. The Cro-magnons who replaced the Neanderthals in Europe, in any case, were able to survive and flourish to the end of the last great ice period.

It is a curious but interesting fact that man has on the whole found it easier to deal with relatively harsh climatic conditions than with conditions that are most favourable for vegetation, especially forest vegetation. After the close of the Palaeolithic period came the Mesolithic transitional period when, with milder, moist, climatic conditions, the game on which man had come to depend disappeared. This once more led to profound ecological changes. Forest growth extended over the former snow-covered or tundra regions of the northern hemisphere and with forest growth primitive man apparently found himself less able to cope. The control of vegetation was still largely beyond his capacity. His settlements became isolated and his culture tended to disintegrate. He took to fishing rather than hunting, and he forgot his art. Yet his inventiveness took other directions. The time was rapidly approaching for the adoption of entirely new modes of life, made possible through the practice of agriculture and pastoralism characteristic of the Neolithic age.



CONTROL OF THE ENVIRONMENT AND THE CULTURAL  
SUCCESSION

Archaeology deals with the palaeontological record of man's culture, so that, of necessity, it can only deal with such of his culture accessories as have been preserved. For all the earliest types this means that attention has been focused mainly on his stone tools, and the name 'Stone Age' has been given to that long period of time, perhaps nearly a million years, from the beginning of the Pleistocene till a few thousand years before the beginning of the Christian Era. It is well, however, to remember that for man, wood is a much more important material than stone, though it is not so durable. We have no means of telling how far back man's wooden culture accessories went or how elaborate the earlier examples were. Quite high types of culture have been built up without the use of stone tools or with only the crudest types of stone adzes, &c., e.g. among the Polynesians of to-day. The most primitive type of human being, if he occupied the same kind of habitat as his cousins the apes, probably used a wooden club before he used a stone hand axe, though, as we have noted, if he lived along the sea-shore, stone implements would be more useful to him in breaking open the shells of shell-fish.

Though the fossil record of man's culture accessories is so incomplete in certain respects, yet the materials discovered, on the other hand, are so abundant that other difficulties arise. Only in a few cases are they definitely associated with fossil remains of man's skeleton, so that it is impossible to know, with certainty, what type of human being was responsible for many of the separate culture types. Again it is very difficult to be sure that widely separated geographical regions, which show records of similar cultures, as indicated by stone implements, possessed them contemporaneously or even approximately so, though in the course of time, by paying close attention to correlations between geological or climatic changes and man's culture, in the way we have already indicated in brief outline, as well as by further discoveries of association between man's own remains and those of his culture, this difficulty, it is hoped, will gradually be overcome. In the meantime it is best to regard terms such as Chellean, Mousterian,

or Aurignacian as phases of culture rather than definitely dated periods. It is interesting to note, in any broad survey of man's cultural progress, some of the most outstanding inventions and discoveries and their far-reaching effects. First of all there are the so-called eoliths of Reid-Moir which some archaeologists claim to have found as far back as the Upper Miocene. Others refuse to believe that they are the work of man, but regard them as the results of natural forces. Then comes the definitely shaped 'hand axe' or *coup de poing*, an axe-like or wedge-like shaped stone of flint, quartzite, or other hard rock-material which was held in the hand and doubtless used for a great variety of purposes. The owner probably used wooden tools as well but used them separately.

The next step forward came with the invention of hafting, when stone tools were combined with wood which was used to form a handle. The wooden handles have long since perished, but the stone parts remain and the result is an increased variety of shapes, not only large stone axes or adzes but smaller spear points, &c. Bone, horn, and ivory also come into evidence at this stage, tending to replace stone. Spears, javelins, harpoons, and similar weapons of defence or offence are no longer made entirely of wood.

The use of a stick for digging up roots and bulbs must go very far back. The weighting of this stick by pushing it through a perforated stone is a device which, among the aboriginal Palaeolithic Bushman tribes of Africa, at least, was a very early improvement. The principle of leverage and its applications in different forms of digging stick does not demand a very advanced intelligence, and from the digging stick the spade has developed, while the hafted adze possibly led on to the hoe.

The discovery of the control of fire and its application has already been referred to. It undoubtedly was one of man's greatest achievements in all time, yet it was accomplished at a very early stage of his evolutionary history. The need for vessels to contain food and liquids must have been felt by man at an early stage of his development, and use may have been made of gourds, coco-nuts, horns, shells, or other naturally occurring containers. How early basket making

occurred it is difficult to say, though there is evidence that in Kenya it goes back to the upper Palaeolithic. Moulding is known to go far back in the Palaeolithic, but pottery making is only developed, to any extent, in Neolithic times. It has proved of the greatest assistance to archaeology in tracing the later stages of development in the culture of ancient man, and in itself it must be ranked as one of man's greatest inventions.

From the beginning man not only used tools and implements or weapons in his hand, but he also was accustomed to throw missiles. Monkeys do the same. Throwing-sticks or boomerangs are examples of primitive weapons of this character. Spears of different kinds are thrown and a further elaboration is the 'spear thrower' in use among various savage peoples. The bow and arrow appeared later and marks another distinct stage of advance. How early the principle of the sling was discovered it is impossible to say, though some archaeologists identify 'sling stones' but without very much certainty.

It is perhaps unnecessary at the present stage to pursue this very big subject any farther. As previously remarked the history of man's conquest of his environment is also largely the history of his inventiveness. He is fortunate above all other animals in that his material culture can be handed on from generation to generation.

The student of human ecology must endeavour to keep himself acquainted at least in outline with the rapidly increasing content of the subject-matter of archaeology and pre-history generally. A brief sketch, therefore, of some of the more important facts established will form a fitting conclusion to the present chapter. The terms employed are those of the classical central and western European areas where the subject was first developed, but brief reference is made to East African and South African cultures as well.

1. *The Lower Palaeolithic.* The Pre-Chellean (or Strepyan) period saw the beginnings of the fashioning of crude stone implements. The Chellean culture as we have seen is extended over an immense area from western Europe to India and south to South Africa, where it is known as the Stellenbosch culture (Lower or Middle). It has not been found,

however, in central or eastern Europe. It is characterized by the 'hand axe' already mentioned and smaller stone implements with uneven edges. Even according to the shorter estimates it must have endured for about a hundred thousand years, ending about 100,000 B.C. The Acheulean culture followed and lasted perhaps until about 50,000 B.C., though many authorities would greatly extend both periods. It occurs also in Kenya, and in South Africa corresponds to the Upper Stellenbosch. Hand axes are still characteristic, but in the 'Clactonian industries', which are either Upper Chellean or Lower Acheulean, in the same gravel beds with the hand axes, flaked tools (small chopping tools, scrapers, and disks) are found, while in western Europe the Levalloisian flaked tools are of Middle or Upper Acheulean date.

It is difficult, as we have seen, definitely to associate any particular type of mankind with these early cultures. Pilt-down man is of Chellean date and so is Heidelberg man, but the latter was discovered in central Europe outside the Chellean culture region, and he is sometimes supposed to be associated with a so-called pre-Mousterian industry and to have given rise to the Neanderthal race.

2. *Middle Palaeolithic.* This consists in Europe of one cultural phase, the Mousterian, definitely associated with Neanderthal Man in central and western Europe and as far south as Gibraltar and eastward to Palestine. It occurs also in Kenya where, according to Leakey, it was contemporary with an Aurignacian phase. In South Africa the middle Palaeolithic begins with the Fauresmith culture followed by Glen Grey, Pietersburg, Howiesons Poort, and Stillbay cultures corresponding typologically to the Mousterian and Solutrean of Europe but with many added elements. It is difficult to say how far man of the Neanderthal type (Rhodesian man) was associated with the Middle Palaeolithic cultures of South Africa. Certainly the Mousterian-type implements of the Springbok flats are associated with Springbok man, who was of *Homo sapiens* type, while Keith definitely assigns the skull found in the Fishhoek cave, with a Stillbay culture, also to *Homo sapiens* and regards it as of a proto-bushman type. The Boskop fossil skull, which was more or less contemporaneous with Springbok man, is classed as ancestral to Fishhoek man.



So all the available evidence points to the Middle-Palaeolithic or Mousterian-type culture of South Africa as belonging to *Homo sapiens* and not to *Homo Rhodesiensis* or any similar Neanderthal type. The Mousterian industry itself shows distinct advance. The hand axe, formed from a single stone, is only prominent at first. It becomes replaced by flaked implements retouched on one side, and the finer flakes were formed into small borers, points (triangular or leaf-like) and scrapers, notched scrapers, and awls. Lance heads suitable for attaching to hafts make their appearance for the first time towards the end of this phase.

The Neanderthals lived in caves, were acquainted with the uses of fire, and used not only the flesh of animals for food but also used their skins, which they prepared by means of their flint scrapers into covers and clothing. They hunted with spears and lances fitted with flint heads, and with throwing stones which are often found in great numbers. For the larger animals they probably also used pit-traps. It is also possible that Neanderthal man, on occasion, pursued cannibalistic practices. Keith (1931) remarks 'there is a growing volume of evidence which convicts early man of a fondness for animal brains and perhaps also for human brains'. Skulls have been discovered that had definitely been cut open when the bone was still in a fresh condition.

His life in caves, however, undoubtedly did much for his culture. It developed his social life, it developed his thinking, and, by sharing his thoughts, he developed new ideas. We know that he had begun to think even about the meaning of life and death, for Neanderthal man had adopted ceremonial burial; that is why so many skeletons have been preserved. The dead were buried in shallow graves inside the caves, and beside them were placed weapons, implements, and food.

3. *Upper Palaeolithic.* (a) The Aurignacian is the term applied in Europe to the first phase of Upper Palaeolithic culture and it is definitely associated with *Homo sapiens*. Among those earliest arrivals of our own species in Europe there were more than one distinct race. Cro-magnon is the most important—a tall, large-skulled, long-headed, strong-faced type; the Combe-Chapelle race, smaller and more delicately made with a long narrow head and a low, somewhat

receding, forehead; the Grimaldi race, a somewhat negroid type, and, in later Aurignacian times, the Predmost race of Moravia, allied to the Cro-magnons, but with heavy brow ridges. The culture of these people of Aurignacian times shows advances in several directions. They used side scrapers and end scrapers and knife-like implements, often beautifully curved, and ending in a point. The 'burin' was an important tool used for cutting incisions in bone or reindeer horn, which, when deepened, allowed strips of the bone or horn to be cut out. Then by rubbing these in a notched flint, implements (skewers, awls, &c.) could be produced. Spears (and possibly arrows, though this is uncertain) were straightened by drawing the wood backwards and forwards through a hole cut in a piece of reindeer horn—a 'shaft straightener'. The use of bone, horn, and ivory marks a very distinct stage of cultural progress.

Like the Neanderthals, the Cro-magnons buried their dead in a ceremonial way. They were commonly covered with red ochre and placed in their graves (which were lined with blocks of stone and covered with stone slabs) with whatever they valued most; shell necklaces, head-dresses of shells, breast-plates or girdles of shells, teeth or bones, armlets, bangles, leg-bands, &c., ivory beads and similar articles, as well as the more useful tools already mentioned, have all been recovered from such graves. It can safely be assumed from their use of sewing implements and love of ornamentation that their dresses were far more elaborate than those of their Neanderthal forerunners.

The invention of the bow and arrow, if it was made as early as this, would have the effect of making the life of Cro-magnon man as a hunter less difficult and precarious. In any case, he seems to have had more leisure, for he began to think of other than merely useful accomplishments. The Aurignacian period saw the rise of art. The Cro-magnons drew on the walls of their caves, with flint pencils, the pictures of animals of all kinds, as well as of men and women; they also learned to paint and carve, and they modelled animals in clay. Some of their sculpture represents female figures whose corpulence is much exaggerated, probably because of magical ideas regarding fecundity.

(b) The Capsian culture of North Africa and south-eastern Spain was contemporaneous with the Aurignacian, but continued much longer until the Azilian phase of European culture. It has a distinctive art of its own differing in style both from Aurignacian and the later Magdalenian art with which it was also contemporaneous. Human figures play a prominent part in Capsian art, details of clothing and personal adornment being shown, with hunting scenes, fights, or dances, often portrayed in a vivid and masterly fashion. The later Capsian culture possessed a lithic industry of a peculiar type, in which minute implements of geometrical design played the chief part. This culture had a very wide range from Spain, through North Africa to Syria and perhaps farther. The Capsian art resembles closely the Bushman art of South Africa, and similar rock paintings of animals and hunting scenes have been discovered in Central India.

(c) When the Aurignacian culture of Europe came to an end it was replaced by the Solutrean which appears to have originated in Asia or Eastern Europe. Little is known of the people who possessed it except that they roamed all over northern and western Europe but did not cross the Pyrenees. Though bone and ivory tools continued to be used, the Solutrean was a period when the working of flint reached its highest pitch of perfection. Flakes were detached from a piece of flint by the pressure of a bone implement, instead of by chipping. The whole surface of a piece of flint could be flaked in this way, giving a 'laurel leaf' appearance to the finished article. Within historical times American Indian tribes have been using the same methods, so the technique is well known.

(d) The Magdalenian culture did not enter Europe from outside, but was a local development, starting probably in the region of the Pyrenees, and extending later through France, Germany, Poland, and Hungary. This culture belonged to a race regarded by Keith as Cro-magnons, who continued to occupy the regions concerned. Their skeletons have been discovered in France, the first one near Chancelade, so they are sometimes referred to as the Chancelade type. Some seventeen skeletons are now known. The Chancelade skull has many Eskimoid features, and Sollas and other authorities are of the opinion that the people who inhabited Europe in

Magdalenian times were not Cro-magnons, were not even Caucasians, but were of yellow or Mongolian stock closely akin to the Eskimo. Certainly the modern Eskimo has retained many of the features of the Palaeolithic culture, but Keith rejects these views. The Chancelade man, he thinks, in spite of his Eskimoid resemblances, is really a representative of the European, or white, stock. The Magdalenian culture is the best known of all in the Palaeolithic, of which it forms the climax. Yet it seems to have very little connexion with the preceding Solutrean culture. Flint implements, in Magdalenian times, seem to have been regarded as of quite secondary importance, used probably mostly for fashioning the more elaborate bone implements. Bone javelin points, often elaborately decorated, are found in considerable numbers, as well as lances, barbed harpoons, and spear or dart throwers (throwing-sticks). The use of harpoons shows that fishing, as well as hunting, was engaged in. There are also many bone implements the exact use of which remains uncertain. The bow and arrow was in use by this time, if not earlier. This is proved by numerous rock paintings.

During this period the climate was again becoming colder. It was the final phase of the last ice age, and is sometimes referred to as the 'reindeer age'. Probably most of the clothing of the people was made from reindeer skins, which were sewn together. The sewing was done with remarkably fine sharp-pointed needles made of bone, with eye-shaped or round holes drilled in them by means of flint awls. Stone lamps were used for illuminating the dark caves, but some of the drawings found there would seem to show that wooden huts or tents were also occupied.

The Magdalenian was pre-eminently the age of art, which now reached a truly astonishing stage of perfection. With the omission of all unnecessary detail, the figures of animals are often marvellously represented, in motion or browsing or showing fear or some other distinct and characteristic emotion. Many of the drawings are life-size, yet wonderfully accurate. The painting materials used have been discovered and include flint pencils, paint palettes and paint tubes made out of birds' bones. The paints themselves consisted of oxides of iron or manganese, giving a variety of colours, red, yellow,



orange, and blue-black. They were laid on probably with a brush, as is done by the modern bushmen. The paints were also made up into crayons. The arts of engraving and animal sculpture reached an equally high level. At their best all those forms of art show not only highly developed powers of expression but also keen observation. Some of the drawings, of course, are crude, as if they were the work of beginners. It has even been suggested that something of the nature of Art schools must have been in existence. A further distinction has been drawn between 'home art' (sculpture, reliefs, bone silhouettes, engravings on bone, &c.) and 'cave art' (engravings and paintings on the walls of caves). (Burkitt, 1929.) The reasons given for the development of the various forms of palaeolithic art are partly that they were due to the desire for self-expression and pure decoration, but partly, at least, and especially in the case of Cave Art, that it was bound up with the practices of sympathetic magic. We shall see later how important magical beliefs and practices of all kinds are in the life of modern primitive peoples. It has been assumed that Palaeolithic man was in no wise different. The underlying motive was the necessity for securing food and thus the frequency of animal representations and hunting scenes becomes understandable. The authorities, however, are not all agreed on this interpretation.

At the close of the Palaeolithic there came a marked change of climate in Europe. Arctic conditions disappeared and forests expanded. The disappearance of the animals he used to hunt forced man to change his habits and mode of life. The characteristics of Magdalenian culture disappeared. Art was given up and other interests took its place. Whether the Cro-magnon race also disappeared or its descendants live on is a point on which there is a difference of opinion. In any case new races appeared as well, one or two of them broad-headed instead of long-headed like their predecessors, and the effects of the new racial admixture certainly began to be apparent from now onward though it may have had an important effect from a much earlier period. The new races occupied isolated areas in Europe during a transitional period to which Burkitt (1929, 1933) has applied the term Mesolithic.

4. *Mesolithic*. As already mentioned, with a change of

climate to a milder moister type and the advance of forests, man's culture in many respects seems to have deteriorated during this period. Burkitt divides the isolated cultures into an earlier and later series. The first four mentioned, which are the earlier, are more or less directly connected with the Palaeolithic cultures.

(a) Tardenoisian culture occurs in Britain, France, and Spain, and is regarded as the result of expansion of late Capsian culture from the south. It is characterized by pigmy flints which may have been hafted in numbers so as to form a single tool. While most of the human remains associated with it are of a curious primitive type, a certain number of the skulls discovered are of the broad-headed type to which the modern Alpine race of Europe belongs.

(b) Azilian Culture is found in the region where Magdalenian culture flourished, in southern France and the Pyrenees, but also in Scotland and in South Germany and Switzerland. Its characteristic implement is the harpoon with two rows of barbs usually made of stag's horn. Crudely painted river pebbles are frequently found and the minute flint implements of the Tardenoisian-Capsian culture also occur.

(c) Maglemosean culture is found in the Baltic regions extending as far as Belgium and Holderness in Yorkshire. It occurred during the period when the Baltic was a fresh-water lake, the so-called 'Ancylus Sea'. Single-barbed harpoons, stone and antler tools are characteristic. The people of this culture were lake-dwellers, living probably on rafts. Some of the human remains found appear to be of the old Cro-magnon race, but a broad-headed element is also present.

(d) Swiderian culture is found below certain ancient dunes in Poland and includes a number of pigmy tools.

(e) Asturian culture is named from the province of Asturias in Northern Spain but extends also to France. A pick made from a chipped river pebble is characteristic and bone tools also occur. Large quantities of the remains of shell-fish are a feature.

(f) Kitchen Midden culture is essentially a sea-side type. It is found round the shores of Scandinavia and the South Baltic, but it is much later than the Maglemosean culture

and occurred at the time when the Baltic was again united with the North Sea. Large mounds of shell fish remains with rough stone and bone implements and flint chisels are characteristic. Primitive graves are a feature. The skeleton of the dog occurs, and primitive crudely decorated pottery.

(g) Campignian culture is similar to the Kitchen Midden culture but is found farther south, in Belgium and France, and also in Italy and Syria. It is usually supposed to have entered Europe from the south-east. It shows pit dwellings, which were doubtless roofed over, containing hearths with cinders, and the same crude tools and coarse pottery. In many of these Mesolithic cultural periods, perhaps within all, men lived more by fishing than by hunting. The importance of shell-fish for the more distinctly sea-side types is obvious. Though during this transitional period the art of the palaeolithic man was forgotten; though tools and weapons and probably clothing and ornaments were in many ways crude and less elaborate, in some respects slight progress in inventiveness is shown.

5. *Neolithic*. The Neolithic period in Europe was a relatively short one, and in out-of-the-way places survivors from the Mesolithic period remained until the arrival of the first users of metals. The true Neolithic peoples, however, continued to use flint tools, though they were made not by chipping or flaking, but by a process of grinding and polishing. Now as Kroeber (1923) has pointed out, more dexterity is required to produce a chipped tool than a ground one, yet the chipping method was the earlier. The processes involved in grinding and polishing are laborious and require more patience and forethought.

‘Dexterity is therefore replaced by qualities of what might be called the moral order. To think ahead, to sacrifice present convenience to future advantage, must have been foreign to the way of life of earliest man. Therefore they chipped. It was not until man had learned to restrain their childish impulse to work only for the immediate purpose, and had acquired an increased self-control and discipline that the grinding of stone came into use.’

To understand, however, the Neolithic culture of Europe, it is important to note that it was not an indigenous evolution but was due to the arrival of a higher type of culture from

the east, which spread westward partly along the Mediterranean and the Atlantic seaboard, and partly overland through central Europe. While western Europe was still using stone implements, in Asia the Palaeolithic had already been superseded by the age of metals, and the Neolithic period in Europe is to be regarded as little more than the first wave of the new culture whose effects took longer to be made apparent, being farther away from the eastern centre in Mesopotamia from which it had to travel.

Two immensely important features were characteristic of this new culture, the practice of agriculture and the domestication of animals. The full significances of this will be better appreciated at a later stage of our discussion, after modern agricultural and pastoral peoples have been described and contrasted with hunting and food-gathering types. Archaeology also lays stress on the fact that this new culture possessed fine pottery. While the peoples possessing it did not live in cities (though these had already been brought into existence by the far more advanced ancient civilization of the East), yet they did live in settled villages. Neolithic peoples possessed every type of domestic animal except the horse and, in their agriculture, used both the hoe and the plough, used a flint sickle for reaping their crops, cultivated the barley and different varieties of wheat and millet, and ground the grain in hand mills of the mortar and pestle type, grew flax and practised weaving, carried on mining operations to obtain flint on an extensive scale, e.g. at Grimes Graves in Suffolk, where shafts were sunk to a depth of forty feet, and in many other directions demonstrated the advances made possible by a more settled mode of life and a more constant reliable food supply. Pottery making, especially, made notable progress showing that Neolithic man possessed not only artistic ability but scientific knowledge and skill. Vessels were both engraved and painted and in many cases very beautiful articles were turned out. The dwelling places of this period were, in some of the simplest cases, similar to the pit-dwellings of the Campignian type already described, but in later Neolithic times well-constructed wooden houses of two or more rooms, even of two stories were built.

The Neolithic culture, however, as already indicated, was



not uniformly dispersed over Europe. Three or four types are distinguished.

- (a) The Alpine Lake-dwelling culture of Switzerland, the first to be described. The people lived in quite large villages of houses built on piles driven into the floor of the lakes.
- (b) The Danubian culture of the region of the Danube—a true peasant culture, of peaceful industrious people, who possessed apparently no weapons (except perhaps a disk-shaped mace-head) and lived in open unprotected settlements.
- (c) The Painted Pottery Culture of eastern Europe, the advanced type. The people, in addition to stone implements, used copper in small quantities and gold. Some of their settlements were strongly fortified. Their pottery, elaborately painted, shows marked advance over the other types. They also painted their bodies. This culture was apparently of eastern origin.
- (d) Neolithic culture of Thessaly—similar to the last-mentioned but differing in details.

There are certain features common to them all on which Archaeologists lay stress, e.g. the so-called 'shoe-last celt'. They all made fine pottery (though differently in the different regions) and they all made clay figures or idols. For further particulars, Dawson (1933) should be consulted.

The villages and settlements have left a record of the life of the peasant agricultural people of this time, but information regarding neolithic life and culture has also largely been obtained from the tombs of the period, which were often elaborate structures. The simplest form is the 'dolmen', consisting of a large slab of stone supported on three or more uprights. The passage grave, corridor grave or *allée couverte* consists of a covered chamber reached by means of a roofed corridor. There are several varieties of this type. The 'stone-kist' consists of a small chamber buried beneath a tumulus, a type which continued into the Bronze Age. Besides the tombs 'standing stones' often of enormous height, and weighing many tons, were commonly erected. They are known as 'menhirs' and circles of these are known as 'cromlechs'. These are particularly characteristic of the Neolithic culture

which spread into Europe not directly from the east and south-east, but first of all to the Iberian Peninsula, and thence along the Atlantic seaboard until it reached the British Isles and the Baltic. It is designated the 'Megalithic culture' and has also spread eastward in Asia as far as India and the Pacific. It is the culture for which Elliot Smith, Perry, and their followers have found a centre of origin in Egypt. It is generally believed to have been somewhat superficial in its influence (unlike the main overland invasion of Neolithic culture) and may very well have been the result of the somewhat transient visits of sea-farers or traders.

6. *The Ancient Civilizations of Asia and the Near East.* Only brief reference can be made to this important part of pre-history, but at the outset one ecological fact requires emphasis. At the time when western Europe was passing through the last great ice period, the cyclonic storms, which to-day are the main characteristic of that region, followed a much more southerly course over the Mediterranean, while eastward from it, over the region which lies between the Mediterranean and the Indian Ocean the climate was probably much moister than it is to-day. Conditions, therefore, were suitable for the maximum output of human energy and for the building up of the highest type of civilization. When due account is taken of the starting-point, the progress made is probably to be regarded as equal to, if not greater than, that of any other period in man's history. During the Ice Age, geographical conditions east of the Mediterranean were also different. The Black Sea and the Caspian were probably united, the Persian Gulf was larger and at times probably formed an inland sea as did the Red Sea. The whole of the western Asiatic region formed an important bridge joining Asia, Africa and Europe. The mountainous regions were covered with ice, but, as that disappeared, were occupied by the tall broad-headed Alpine type of man, being the centre of diffusion for that race, which as we have seen, colonized Europe during Mesolithic times. South of the mountain regions in post-glacial times, the inhabitants belonged to the long-headed Semitic race, which is allied to the Hamitic race of North Africa, while later, at the beginning of the historic period for this region, the low-

lands of the Central Asiatic steppes to the north are known to have been occupied by people who spoke Aryan languages and belonged probably to the Nordic race.

The beginnings of this Asiatic culture have been discovered at Susa in South-west Persia, the capital of the ancient kingdom of Elam. It was a painted-pottery, peasant culture, in which the pottery was wheel made and of the finest prehistoric type known, being extremely thin and elaborately decorated. Similar types were later discovered in western Turkestan and in North and West China. In India in 1924, a painted-pottery culture was discovered in the Indus valley, of a true city type, with highly developed art and architecture and pictograph script. Over all this vast region agriculture was practised and the pig had been domesticated but not at first apparently, the cow, sheep, or horse. Painted-pottery cultures, according to Dawson (1933), in time spread out over a period of some 3,000 years and in space they reached from the Indus to the Orontes and from the Danube to the Hoang-Ho. They lie at the root of all the higher cultures. It was in Mesopotamia that the progress towards a higher culture and civilization became most evident. Originally Mesopotamia was occupied by Semitic peoples, but the higher culture was probably introduced from Elam by the Sumerians, an Alpine or Mixed race, which afterwards became gradually absorbed by the native Semitic races.

Once more it may be pointed out here that the full significance of the passage from the hunting to the food-producing type of ecological relationship with the environment can only be grasped after proper details of man's ecological history and classification have been entered into. The practice of agriculture led to the birth of a peasant religion and the cult of the earth mother or goddess. The city, according to Dawson (and he is probably right) had a religious origin. From the beginning it was a 'Sacred City' and about the beginning of the fourth millennium B.C. it transformed the ancient world. 'All over the East from Crete and Egypt to South-west Persia, and even to India, the Sacred City appears at the dawn of history as the essential organ of the higher civilization'. For the rest of the fascinating story so far as it is known to-day, the works of Dawson (1933) or

Childe (1925) or MacCurdy (1924) or Myres may be consulted, but other references to it will be made at a later stage of our discussion.

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## VIII

### THE ECOLOGY OF THE FOOD-GATHERERS

Introductory—Food-gathering Types—Their Environments—Responses to the Environment and General Ecological Characteristics of the Food-gatherers—Culture—Autecology—Bibliography

#### INTRODUCTORY

THE subject of human ecology having been approached in the preceding chapters, from many different angles, and at the same time the essential unity of the biological (environment—function—organism) triad having been continually emphasized, it is now possible to proceed to deal with the general ecology of the living races of mankind. For some of them the environment remains a relatively simple unchanged environment and their relationship to it is also a comparatively simple one. This is the ecological division of mankind to be described in the present chapter. They have been called 'food-gatherers' by Dr. W. J. Perry in his work on *The Children of the Sun*. They live by hunting and food collecting and have neither domesticated animals, except, in a few cases, the dog (which from very early times entered into a sort of partnership with man and assisted him in his hunting to their mutual advantage), nor have they begun to practise agriculture. They are contrasted with the 'food-producers' who have devised means of securing a more reliable and constant food supply. These terms are convenient, since they represent a fundamental distinction in cultural levels more or less recognized and accepted by all the social sciences. The distinction is roughly the same as that which existed between Palaeolithic and Neolithic man. At the same time, as was pointed out in the last chapter, it is unsafe to assume that the living food-gatherers are ecologically similar to Palaeolithic man. The former have a much longer cultural history and have in all parts of the world to-day come into contact with peoples of more advanced culture. Nevertheless there is much to be learned from a careful comparative study of their ecological behaviour. While there are still numerous food-gathering types in existence, their total numbers in recent

times have rapidly diminished. The Tasmanians, one important example, have now become extinct. The same fate may soon overtake others, or if they do manage to survive they will probably sooner or later abandon their ancient mode of life.

#### FOOD-GATHERING TYPES

To begin with, we may concentrate for the moment on the last term of the triad and note a few points regarding the peoples themselves without much reference to their environment.

1. *The Tasmanians.* The number of Tasmanians occupying their island, when it was first known, has been estimated as being as many as 20,000. Probably this is exaggerated but, in any case, after the war of 1825-31 there were left only about 200. From 1834 onwards efforts were made to preserve the remnants of this race, but without avail. The last survivor, Truganini, died in 1877. Anthropologists differ regarding their racial affinities. Though not pygmies in stature, they were related in physical characters to the Negritos or were intermediate between them and the Papua-Melanesians. Sollas (1924) gives a concise account of the conflicting views regarding them and concludes that they appear to have been the surviving descendants of a primitive race, elsewhere extinct or merged into a preponderant alien population. Their primitive ancestors, he thinks, may have been widely distributed over the Old World. They may have crossed to Australia and Tasmania by means of their rafts at a time when the channels separating these islands from New Guinea were narrower and yet wide enough to bar the way to the rest of the Oriental fauna.

The Tasmanians were of medium height (the men 5 ft. 1 in. to 5 ft. 8 in., the women 4 ft. 3 in. to 5 ft. 4 $\frac{1}{4}$  in.). Their skin was almost black in colour or slightly brown, their hair woolly like the Negro. Their eyes were small and deep set, with prominent overhanging brow-ridges, the nose short and broad, with distended nostrils, the mouth big, the teeth large. The skull was dolichocephalic, like Palaeolithic man, but of peculiar outline (flat-headed or platycephalic) and of small capacity, the lowest met with among recent races,

being much smaller also than those of men of the old stone age.

2. *The African Pygmies or Negrillos.* These are distributed across equatorial Africa in a zone extending through three degrees north and three degrees south of the Equator. In Uganda they are now much diminished in numbers, though at one time believed to have been the principal inhabitants. They are divided into several distinct tribes which bear distinct names in different geographical areas. The Akkas inhabit the Upper Nile and Niam-Niam country, the Wambutti ('mButi) the Ituri forest, the Batua the Congo forest, and there are many smaller tribes.

Their average height is about  $4\frac{1}{2}$  ft. but individuals are met with only 3 ft. tall. Their average weight is about 77 pounds. They have flat heads with receding foreheads, broad flat noses, long upper lips, prominent upper jaws, large mouths, receding chins, long arms, large feet and long toes, short legs and protuberant abdomens. Steatopygy (projecting buttocks) is not common, but occurs. Their hair is very short and woolly, usually of dark rusty-brown colour, but their bodies are plentifully covered with a yellowish downy hair which is longer on the back and limbs.

Though small they are, as a rule, well-proportioned and very agile, being capable of remarkably quick movement through the forest. They go about quite naked, or wearing small pieces of skin, or (in the case of the women) bunches of leaves.

3. *The Bushmen.* The pure Bushmen of South Africa, who show little or no admixture with other races, are reduced to very small numbers. They are a small though not quite dwarf or pygmy race averaging about 4 ft. 10 in. in height. The Bushmen of the Northern Kalahari on the other hand are tall, averaging, it is said, 5 ft. 10 in., while individuals of well over 6 ft. are often found. The Bushmen are of a yellowish-brown colour with wrinkled skins. They have small broad (mesocephalic) low-crowned (platycephalic) heads, though in the northern tribes there is a tendency for the heads to be narrower and higher. Their cheek-bones are high, the eyes deep set, the nose low and very broad, and the ear is characteristic without a well-developed lobe. Their

thigh-bones are bowed outward, their backs are hollow, and the women often show considerable steatopygy.

4. *The Andamanese*. These inhabit the Andaman Islands in the Sea of Bengal. Their numbers are small, probably not more than 1,800 altogether, having greatly diminished during the last fifty years. The average height of the men is 4 ft. 10½ in., of the women, 4 ft. 6 in. The face is broad, eyes prominent, nose sunken at the root but straight and small, lips full but not thick, chin small but not retreating.

5. *The Aborigines of Australia*. The most noticeable feature of the Australian aborigines is the fact that they have wavy hair and belong, therefore, to the Cymotrichi, like ourselves. The men wear it long and grow beards, but the women cut their hair short. Their average height is 5 ft. 5½ in., their skin is a dark chocolate brown, their skulls dolichocephalic (platycephalic), with flat, retreating foreheads and prominent brow ridges. Some go completely naked, others use skins, but these, like the necklaces of shells or kangaroo teeth, nose-pins, &c., are used more for decorative purposes than as clothing.

6. *The Terra del Fuegians*. The Fuegians, like all other American aborigines, belong to the straight-haired (leiotrichi) or Mongoloid race. They are of low stature (average 5 ft. 2 in.) with a strong tendency to dolichocephaly. They have narrow foreheads, longish faces, and brown or reddish-yellow skins. They represent a race which elsewhere has reached a much higher level of culture, and thus differ from the other types of food-gatherers which we have considered so far.

7. *The Eskimo (Esquimaux)*. These inhabit the Tundra or cold desert climatic area from Greenland to Alaska, extending also to the extreme north-east of Asia. They are a short or medium race, their average height being 5 ft. 2½ in. They have high heads, with broad, flat faces and prominent cheekbones, high, narrow, moderately prominent noses, black straight hair and eyes of Mongoloid type. Their cranial capacity (1,550 c.c.) is said to surpass that of some of the most civilized peoples of Europe (Sollas, 1924).

These are some of the most important of the food-gathering peoples. Others include the Veddahs of Ceylon, a



dwarfish race of probably pre-Dravidian affinities, the Semang of the Malay Peninsula, another small race of Negrito stock, that live mainly on vegetable food and only occasionally hunt for meat, the Sakai of the same region, dwarf Australoids, who are mainly hunters, the Kubu of Sumatra, who live entirely in the forest, in shelters of branches and leaves built on platforms, the Punan of Borneo, Negrito tribes of the Philippines and various food-gathering tribes among the North American Indians.

The main point that emerges from this brief survey is that cultural development does not depend primarily on race. The food-gatherers belong to a great variety of racial types—Negritoes from Africa, Asia, and the Philippines, Australoids from Ceylon, Malaya, and Australia, Mongoloids from Asia and America. Only the so-called Caucasian man (the Nordic, Alpine, and Mediterranean races) is excluded. Racial characters, however, while not supremely important in human ecology, cannot be altogether neglected any more than plant taxonomy can in plant ecology. It is important to know one's men just as it is to 'know one's plants'.

While the majority of the typical food-gatherers are to be regarded as ethnologically primitive from the racial point of view, it remains difficult to decide to what extent their racial characteristics are the result of a process of degeneration and how far they represent true primitiveness. Some, like the Fuegians and the Bushmen, have, it is certain, deteriorated from the cultural standpoint, and, if the modern Bushman has, as is likely (on the authority of Keith), descended from the Fishhoek and Boskop types (of which the latter had a much greater skull capacity), then there has been physical degeneration as well. Another point, which is difficult to decide, is how far this has been due to the influence of their environment, but that definitely concerns the middle term of our triad.

#### THE ENVIRONMENTS

The climatic or physical environments occupied by the food-gatherers, at first sight, appear to have little in common. They range from the dense equatorial forests occupied by the pygmies and others to the semi-desert conditions of the

interior of Australia, and the Kalahari region in South Africa, to the sea-shore habitat of the Fuegians and cold desert or frozen regions of the Arctic occupied by the Esquimaux. They do, however, as already pointed out, have this much in common; they are all of such a nature that they cannot easily be altered even by the most highly civilized types of mankind, and these, as a rule, decide to leave them alone, unless they happen to contain any factors, e.g. mineral wealth, which civilized man requires. The environments must, of course, provide a sufficient food supply for the food-gatherers to be able to exist, and for this ecological division of mankind, the living environment is of primary importance. Among the inorganic environmental factors, water is sometimes a limiting one, and for such food-gatherers as the Australian or the Kalahari Bushmen their relationship to their water supply is something that continually affects their activities, but it is the plants and animals that surround them and are used by them that are fundamental in determining their general ecological behaviour.

The social environment of the food-gatherers in general has reached no great degree of complexity. Though many aspects of it are best discussed from the functional standpoint, in this place a few facts may be noted. The size of the social group is usually small, sometimes merely a band of close relatives (a family group in the wider sense) consisting of parents, children and perhaps grandparents or other near relatives. Under such extremely simple conditions of social life the advantages are obviously mainly connected with the fact that in any one place, where the food supply (or it may be the water supply) is somewhat scanty it is easier to support a small group (provided it is not too small) than a very large one. The small group too is more firmly united in the pursuit of common ends. However, even under such conditions, the advantages of a larger band co-operating in securing food are made use of on occasion, as when separate groups combine under a single leader (one of the older or wiser men as a rule) in the pursuit of large game or large herds of game. Such elementary types of herd organization remain of the loosest possible description.

While the groups remain small, without any elaboration

of social organization, it follows that there can be no very distinct social classes. All members are more or less on a footing of equality, all must share alike in the task of food-getting and all share the food when it is obtained. The group, except perhaps occasionally, under conditions of abnormal stress, remains perfectly harmonious. This represents the conditions of life pictured by Elliot Smith (1930) who regards the food-gatherer as, by nature, a happy well-behaved child, full of generous impulses and free from vice, representing the survival of a 'golden age' of innocence and Arcadian simplicity which was common to all mankind before civilization was created. The essential geniality, goodness, and kindness of man is really universal so long as his social organization is very simple and he only has the forces of Nature herself to contend with.

Among some of the hunting peoples social organization has developed a certain degree of complexity. Among the Bushmen, in olden times, the hunting band consisted of as many as 100-150 individuals, each separate band being commonly designated by a name which in some cases indicated some physical or other peculiarity of the band itself, but most often the locality where they lived. The tendency among all primitive food-gathering peoples is to identify themselves very closely with their environment. Members of a band hunt freely and collect food over their own territory which they know as intimately almost as they know their own bodies, and they are as careful not to trespass over the territory of another band as they would be if it were a case of trampling on the bodies of their neighbours. They seem to regard their land and the wild life surrounding them almost as part of themselves. Trespass on their land is, as it were, a violence done to themselves. Their territory is part of their ego and any invasion of it—except for friendly visits—is regarded as a direct personal injury. This, though badly understood at the time, is undoubtedly largely the explanation of the quarrels between the early Bushmen of the Cape and the first white settlers. For such simple people it is not the hunting band, by itself, but the band with its hunting environment, the two very closely knit together, that constitutes an organized social unit.

The same applies to the Australian aborigines and is emphasized by Porteus (1921) as an explanation of why the inhabitants of Australia (estimated by Thomas at not more than 150,000 altogether at the time of discovery) were found to be sparsely scattered over the whole continent. As Porteus points out 'The immediate result of the identification of individuals with their particular part of the country is that there is no crowding of the natives into favoured areas'. The tribes remain isolated. Porteus believes that the original invaders, landing on the coast of north-west Australia somewhere between the 15th and 20th degree of latitude, remained for a long period confined to a comparatively restricted area, in which the distinctive problems of the Australian's environment were met with and conquered, and the customs and habits of the people fixed. Afterwards by three lines of migration they spread over the rest of the continent, slowly through the centre and more rapidly around the periphery. The whole social system, therefore, has been evolved to suit distinctly Australian conditions. The struggle is one of man against Nature and not of man against man or tribe against tribe. Martial prowess is of less importance than wisdom and experience, and the wise old men who have survived long periods of drought and scarcity are looked to as the natural leaders. In certain tribes, however, the position of authority is granted temporarily to the fighting man. Social organization in Australia among the food-gatherers has developed farther than it has among similar ecological types elsewhere. While the family, according to Malinowski (1913), remains the unit of society the families are grouped in tribes, consisting of a number of exogamic clans which are either matrilineal or patrilineal. In all tribes marriage is between persons who stand in a certain relation of consanguinity. Whatever the causes that led up to this state of affairs, some of the ecological effects of the arrangement have been clearly enunciated by Porteus.

Since authority and prestige have become centred in the elders of the tribe, nothing has been neglected that would contribute to that prestige or serve to weld that authority into a hard-and-fast system. The two things that are matters of special privilege are food and women, and as regard both



of these, the rights and privileges of the old are carefully preserved at the expense of the younger members of the tribes. This is not, however, designed for the purely selfish gratification of the desire on the part of those in authority to keep all the good things for themselves. In such a vast country there is a natural tendency for the community to break up into tiny groups. In times of plenty this does not matter much, but in times of scarcity there is the utmost necessity for pooling the community's resources. 'There are probably no conditions of life which demand unselfishness so explicitly as does life in the Australian interior.' The rules of food distribution therefore, are very elaborate, not only the food restrictions for the young but the totem food regulations as well. 'Totemism fosters individual unselfishness.' The tabus are so spread out among totem kins that the tribe as a whole does not suffer. At the same time the lessons in self-denial apply to everybody. It all results in mutual dependence. The men of any totemic group are responsible for the maintenance of the supply of their animal or plant. The rest of the tribe benefits. Furthermore many of their important ceremonies are deliberately planned with the object of fostering goodwill among members of the tribe.

As regards marriage customs the effect of the exogamic system is that the number of eligible women, as far as each individual member of the tribe is concerned, is limited. There may be two, four, or eight classes in an exogamous tribe and in the last case the number of marriageable individuals is very few. This prevents quarrels and makes for tribal unity. Generally the old man and men of influence or power secure the young females of the tribe, but the exogamous system lessens competition among the old men themselves. Rivalry between the old men is much more likely to have a disruptive effect than any competition on the part of the young men.

#### RESPONSES TO THE ENVIRONMENT AND GENERAL ECOLOGICAL CHARACTERISTICS OF THE FOOD-GATHERERS

While the food-gatherers, as we have seen, belong to a great many different races and show widely different physical characteristics, it is noticeable that a great many of them are

of a small dwarf type. This is not, however, a universal feature, indeed there is often considerable variation even among those belonging to the same race. We have seen that while the Southern Bushmen of South Africa are small or dwarfish, the Northern Bushmen are tall. This fact raises a very interesting ecological problem. It is possible that the environment may exercise a far greater degree of direct influence on bodily characteristics than the majority of anthropologists have hitherto been willing to admit. Haddon (1924) remarks that, though the Cape Bushmen are usually of short stature, it is well known that many of the early Cape Colony Bushmen, who could obtain good supplies of game, were of quite ordinary size, and even to-day if the very young children of dwarfish parents are taken to farms and well fed, they grow to a fair stature. Since the growth processes are now known to depend so much on the proper functioning of internal glands and their secretions, it may not be so much the quantity as the quality of the food supply and the presence or absence of vitamins or of certain necessary chemical elements (e.g. iodine or phosphorus or calcium or others) that is of importance. Soil conditions may thus exercise a very distinct and specific effect on man, as well as on his domestic animals. The latter fact has already been abundantly demonstrated in South Africa and elsewhere. It may be noted in passing that there are said to be very striking differences in stature among the descendants of the original Dutch settlers in South Africa who have colonized different regions. In Namaqualand where carbohydrate foods are scarce, and most of the ordinary green vegetables cannot easily be grown, the inhabitants live mostly on meat, and a very tall race has been produced. In East Africa too, the purely meat-eating Masai are taller than their agricultural neighbours. It is, of course, a very difficult subject to investigate in a proper scientific way, and with the information at present available, other than purely environmental effects cannot be ruled out. As regards the variation in stature among the Bushmen, Shapira (1930) prefers to explain the pygmy stature of the southern types as being a true racial characteristic, while the increased stature of the northern tribes, he thinks is due to racial intermixture with other and taller peoples.

As regards the general functional responses of the food-gatherers it is not always easy to separate these from their cultural control over the environment, but a few physiological or psychological traits may be mentioned in this place. Whether such are innate or acquired, while obvious in certain cases, in others is not always easy to determine.

(a) The closeness of their identification of themselves with their environment results in a wonderfully intimate knowledge on their part of the plants and animals among which they live; especially among all the tropical or semi-tropical types of food-gatherers, the properties of poisonous plants and other poisons, even antidotes to be used to neutralize their effects, the plants that can be utilized for food and where they occur, how they can be treated if they are naturally poisonous so as to have no ill effects, other sources of food, e.g. grubs, larvae, caterpillars, termites, locusts, frogs, lizards, snakes, &c., the habits of all sorts of other animals, large and small, the knowledge of all these is what occupies the first place in their minds. They apply this knowledge continuously in maintaining their own lives and those of their families. The first necessity is to obtain food and it is a continuous necessity for them. They go after their food, find it, kill, collect, cook, and eat it, then sleep and go after it again. That is their daily round and from one year to another their days are very much alike. The fact that most, if not all, of them have discovered how to produce one variety or another of alcoholic beverage is, however, a point worth mentioning.

(b) For success in the main work of their lives they must possess quick, acute senses, especially of sight and hearing and general alertness. Agility and dexterity and quick reaction to stimuli must also be part of their endowment. They commonly show great courage and resourcefulness.

Porteus carried out a number of measurements and mental tests on the Australian natives and as a result says that

‘considering their unfamiliarity with the test situation the aborigines’ response to tests of prudence and planning capacity, discrimination of form and spatial relations in test material familiar to them was little if any inferior to whites. In tests scored on speed their performance rated low, mainly because working against time was contrary to habit. In

rote memory they were particularly deficient when the test was an auditory one, less deficient, but still very inferior, when it was visually presented.'

'They are not unintelligent, but are certainly inadaptably to a civilized environment.'

(c) Food-gatherers are keen observers and show extraordinary powers of mimicry. This is noted by many different authorities and applies to the pygmies, Bushmen, Australian natives and others. The Bushmen have made use of this gift of theirs to assist in their hunting. They imitate the habits of various animals and copy their appearance so as to deceive the animal they are stalking. The imitative power of the Bushmen is also seen in their dancing. Some of their dances used to be very elaborate and required considerable skill, consisting of imitations of animal behaviour, e.g. the dance of the baboons, or of the frogs or the bees or jackals, wolves, hyenas, &c. They often used to dress themselves up to represent the animals. Their primitive music and dancing is of importance in making for unity, good-fellowship, and ready co-operation in the more serious affairs of life connected with the chase.

(d) With few exceptions the food-gatherers do not store food for any length of time. They are not accustomed to think ahead. It is true that the Fuegians are said to have been accustomed, whenever a whale was cast ashore, to bury large pieces of it in the sand, as a resource in time of famine, and Stow (1905) tells us that, among the Bushmen, at one time, the practice of collecting seeds for winter store was almost universal, an important observation, for it indicates how the practice of agriculture may have originated among similar hunting peoples. Elsewhere, however, in the same work, Stow remarks that the Bushmen took little thought for the morrow. When one feasted they all partook, and when one hungered they all equally starved. They showed remarkable endurance in withstanding the pangs of hunger. This generally applies to the whole food-gathering class.

As regards the Australian aborigines, Porteus points out that, while it is a fact that they are improvident in the matter of food supplies, we must not draw invidious conclusions as to the relation of this to intelligence. Generosity, which is one



of their leading characteristics, is largely incompatible with hoarding, which is considered an offence against tribal custom. The habit of gorging when food happened to be plentiful is noted for practically the whole class. For instance, with regard to the Tasmanians, it is recorded (Keane, 1920, p.161) that at the station on Flinders island a woman was seen to eat on one occasion from 50 to 60 eggs of the sooty petrel (larger than a duck's) besides a double allowance of bread. It has been suggested that the protruding abdomen seen among the African pygmies and others is to be correlated with this habit.

(e) The personal characteristics already enumerated are the most important in respect to their functional relationship to the environment. Others may be catalogued very briefly. They are as a rule bright, good-humoured, cheerful and easily aroused to laughter, though on occasion subject to fits of ill temper and spitefulness. They are keen and alert, not only when closely in touch with Nature and engaged in their daily hunting or food-collecting occupations, but also when gathered together for social purposes. They are for the most part excellent conversationalists, at least in so far as rapid interchange of opinions is concerned. They are sensitive in their feelings and susceptible to ridicule or contempt. They like display. Like children they are fond of 'showing off'. In fact in many ways they appear to us childish, but in this respect they are not unique, for we, like all other types of mankind, are apt to imagine that those who differ from ourselves are childish. Doubtless any of us, if placed in the natural environments of the Bushman or the Australian native or the Eskimo or any of the others, would appear particularly childish and helpless to each of them in turn.

Their power of stoical endurance requires some degree of emphasis. Their food supply is always to some extent uncertain and times of plenty alternate with times of scarcity often very prolonged, when their very survival depends on this important trait. On the whole, for a class that is so intimately in touch with unchanged Nature it is a fairly simple matter to demonstrate rather well-marked correlations between their personal characteristics and their environments.

## CULTURE

The cultural relationships of the food-gatherers with their environment, while having much in common, since the mode of life is largely a uniform one, differ in details as the environments, particularly the climatic environments, differ among themselves. (a) Taking first of all the material culture traits, it is obvious that the methods of obtaining food must vary according to the differences among the animals hunted, the plants, grubs, caterpillars, &c., gathered, and the environmental conditions generally. Thus to take a few examples, the chief hunting weapon of the Bushman is the bow and arrow, the bow made usually from the wood of a special tree (*Grewia flava*) when obtainable, and the arrows being of various types, commonly a reed tipped with wood or bone or in later times with iron, very fragile but always poisoned. The poisons used are obtained from a variety of plants, e.g. *Acokanthera venenata*, *Buphane disticha*, and species of *Euphorbia*, or consist of snake venoms, or the poison of the trap-door spider or that obtained from the grub or chrysalis of the *Cladocera* beetle.

In addition to the bow and arrow the Northern Bushmen use clubs (knob-kerries) and spears, weapons probably borrowed from the Bantu.

In approaching the game the Bushmen used to disguise themselves by dressing up in the skins of animals or in the feathers of the ostrich or simply by tying large tufts of grass to their heads. In their paintings these disguises are frequently indicated. Smaller game or even fairly large species of antelope are often hunted by being run down on foot, especially at certain times of the year or in places where the ground is marshy. Other methods of capturing game are pit-falls and traps, or by poisoning the water at places where the animals come to drink. Fishing is also pursued by the Bushmen wherever possible. Among food-gathering types, where hunting is combined with fishing, it is important to note that, whenever the latter becomes the predominant mode of life, more settled habits are possible and this has often led to considerable and far-reaching ecological transformations. The methods of fishing among the Bushmen vary, funnel-

shaped fish traps, constructed of closely woven reeds, being a common method. While in bygone days the hunting and capturing of animals supplied the bulk of the Bushman's food supply, it was probably always supplemented by collecting fruits and seeds, honey, bulbs, tubers and roots, grubs, caterpillars, frogs, snakes, lizards, locusts, ants, and termites (the 'eggs' of which are popularly known as 'Bushman's Rice'), in fact in collecting pretty well anything that can be eaten. In more recent times, as game has become scarcer and the white man's game laws have to be obeyed, the Bushmen have come to rely more and more on such sources of food. The plants are dug up by means of the 'Kibi' or digging stick which is also used for digging pitfalls for game. If the surface of the ground is hard the kibi is weighted by being passed through a round perforated stone or 'Tikoe'. The Bushmen use the leaves of the Wild Dagga (*Leonotis leonurus*) for smoking, or in recent times *Cannabis sativa*, 'Indian Hemp'. Their pipes are of wood, reed, stone, or antelope horn.

The obtaining of water for drinking purposes (the Bushmen never wash themselves) is as important as the obtaining of food in semi-desert regions. In the dry season, as Shapira points out, it affects tribal cohesion and regulates migration. The hunting band tends to disintegrate into the separate families composing it, owing to the difficulty of obtaining water in quantity. Ostrich egg-shells are used for storing water and are often buried in the ground or otherwise hidden and reserved for future use. If all sources of water supply fail a substitute is found in the succulent fruits such as the water-melon.

The African pygmies are culturally in many ways similar to the Bushmen though of an even simpler type. Their environment is the dense forest. Birds and small game are their staple food. They eat rodents of all kinds which are abundant in the forests. Termites, ants, caterpillars, various larvae, honey, and mushrooms are regarded as delicacies. Nuts and wild fruits they eat as they are available, and migrate from district to district, where they know such are to be found in abundance at different seasons. Van den Bergh (1922) remarks that their digestive organs seem to be deve-

loped a great deal better than ours, for they live on roots which would give us dyspepsia for life, in fact they eat anything and everything that the forest produces which can be eaten. But they also kill larger game. They make traps and nets of vines and creepers in the form of very coarse and irregular meshes. They exhibit great courage and perseverance in hunting the elephant, sometimes following one up for many days on end, shooting their arrows into him and planting spears fixed head down in his way so as to lodge near the shoulders. They also sometimes use poisoned arrows which will kill the elephant without affecting the meat for consumption. They may feed on the carcass for weeks. Vegetable food they eat raw, but they cook their meat in the ashes of their fires.

The Andamanese, according to Radcliffe Brown (1922), are divided into coast-dwelling and forest-dwelling ecological groups. The former are fishers and turtle hunters and make canoes by hollowing out tree-trunks. Their women-folk collect small fish, prawns, shell-fish, &c. They also obtain some food (roots and the flesh of wild pig) from the forest. The forest dwellers are more skilful at pig hunting, are ignorant of turtle hunting, and only use canoes in the creeks. There is also a division of these separate ecological types into tribes which, however, have little influence in regulating social life. The tribes are composed of local communities which are more or less independent and autonomous. Radcliffe Brown points out that, though land is held in common, yet the economic life of the local group is based on the notion of private property. But, except their food, which they must find from day to day, the natives need nothing save their weapons and implements, each man making his own bow, arrows, adze, &c., while the wife makes her basket, nets, and so on. A man may select a bread-fruit tree and it will be regarded henceforth as his private property. A pig belongs to the man whose arrow first strikes it, a honeycomb to the man who climbs a tree and cuts it down. A woman owns the roots she digs up, or the prawns she takes in her net, or the shell-fish she brings in from the reef.

Nevertheless, owing to the custom of constantly ex-



changing presents with one another, almost every object that the Andamanese possesses is continually changing hands. Every one who has food is expected to give to those who have none. The womenfolk make all objects, such as baskets, nets of thread, and personal ornaments, both for themselves and their menfolk.

Of particular interest are the kitchen middens of the Andamanese, which are of great age, sometimes rising to a height of 15 ft. The contents of these prove that the habits of the Andamanese have not varied since a very remote past.

The Tasmanians used stone implements, which were trimmed by chipping on one face only. Many were so crude as to be classed with the eoliths already described. If they had not been observed in the process of manufacture they would all be classed as pre-Aurignacian. They used one type with a blunt hand grip on the one side for all purposes, chopping, sawing, and cutting, and did not, like Palaeolithic man, have separate tools for different kinds of work, such as axes, chisels, picks, &c.

They did not know of the bow and arrow or boomerang, but they used wooden clubs and wooden spears with points hardened by fire and sharpened by means of their stone tools. They hunted the kangaroo and opossums and seals, as well as the emu and other birds. They caught and ate crabs and the women collected shell-fish and birds' eggs. They also ate snakes, lizards, and grubs, but they did not use ordinary fish. They collected and ate roots and fruits and a truffle-like fungus. They made fire by the stick and groove method and cooked their food by roasting. They roasted the shell-fish and the empty shells formed enormous mounds or kitchen middens.

The Australian natives, unlike the Bushmen, have no bows and arrows, but use spears, tipped with hard wood or flint, and throwing-sticks for hurling them, two kinds of boomerang, stone axes or adzes attached to a haft, and stone knives attached to a handle. Their stone implements and tools are very similar to those of Palaeolithic man. They also use bone awls and pins. They use rafts and also well-constructed sewn bark canoes. They hunt the kangaroo, the opossum, the wombat, and other marsupials. The only

higher mammals associated with them are the rat, which they eat, and the dingo or native dog. How the latter got into Australia has been much discussed. Most probably the Aborigines brought it with them.

They eat all kinds of birds from the emu down to small honey-eaters. They also collect and eat turtles, snakes, lizards, grubs, frogs, ants, and shell-fish. Unlike the Tasmanians, they catch and eat fish, using special spears or even fish-hooks to catch them. They also build special weirs for the purpose. The women dig up roots, bulbs, and tubers and collect fruits and seeds. They make fermented liquor, like the Bushmen, from honey, and smoke the leaves of a species of *Eugenia* in a bamboo pipe.

The Eskimo differ from all the peoples already described very widely in their environments and racial characteristics, and distinctly also in their culture, which has remained unchanged for a very long period. Their implements and weapons bear a strong resemblance to many of those of the upper Palaeolithic. They are made of stone, slate, bone, or ivory. They use the bow and arrow, spear with spear throwers and harpoons for hunting or fishing, arrow straighteners, bone needles, bone pins, belt fasteners and buckles, snow picks, hair-combs, and a variety of other articles. They use whalebone for many different purposes.

They have domesticated the dog and travel by means of dog sledges. They hunt the seal, the whale, or the walrus in different areas, mainly during the winter and spring, and the reindeer (caribou) or musk-ox in the summer. Some live by fishing, others catch fish very rarely. They depend almost entirely on animal food, the fats supplying the necessary hydrocarbons. They also use whale blubber as fuel, burning it in stone lamps, during winter. Pottery is unknown to them, but they are skilled carvers of ivory and bone.

(b) The material culture of all the food-gatherers is for the most part bound up with their food habits, and other traits may therefore be dealt with very briefly. In all cases their dwellings are of a more or less temporary nature. The pygmies leave the construction of their simple huts to their womenfolk who bend and interlace the branches of shrubs or trees and cover this with plantain leaves. These structures

are abandoned when they move on in pursuit of game. The Bushmen make use of cave or rock shelters wherever possible, but also construct small temporary bush huts of twigs and grass. Each family within a band has its own hut, with sometimes a separate hut for each wife, if there are more than one in a family. Children sleep with their parents, but the bigger boys and young men usually sleep in the open or share a separate hut, as do the unmarried girls. The Australian natives, when roaming about, searching for food, construct only simple bark shelters or sleep in the open. They do not appear to make use of caves, except sometimes as store-houses for sacred objects. They have, however, semi-permanent camps to which they return at intervals and some of these, e.g. in the far north-west, consist of well-thatched huts of grass. The Fuegians are described by Darwin in the *Voyage of the Beagle* as having wigwams, consisting of a few branches stuck in the ground, imperfectly thatched on one side with a few tufts of grass and reeds. Living chiefly on shell-fish, they constantly changed their place of residence, leaving behind piles of old shells as lasting evidence of their habits. The Andamanese have progressed somewhat farther than the others, having dwellings of three kinds: (*a*) hunting camps of a temporary nature, used only for a few days; (*b*) temporary encampments, where the huts last for two or three months—the usual type at the present time; (*c*) permanent encampments, with better constructed huts and a large communal hut, which would last for several years. The permanent encampment is regarded as the headquarters of each group, but the communal hut has, in recent times, fallen into disuse.

The Eskimo, having to deal with a much more rigorous climate, dwell in snow-houses during the winter but in summer make use of sealskin tents.

The relative impermanence of all types of dwelling-place of the food-gatherers is in itself an obvious adaptation to their environments and their mode of life. Permanent houses are not only unnecessary but, if they were constructed and used, would prove a positive disadvantage since thereby essential mobility would be restricted. Such a degree of permanence as is required is, however, provided for, e.g. in the so-called permanent encampments of the Andamanese or of the

Australians (who also used to store away their sacred objects in special sacred places).

(c) The majority of the food-gatherers go almost or completely naked. Even when the climate makes it necessary to clothe themselves, as in the case of the Eskimo, both sexes of whom wear tunics, trousers, boots or shoes, and often fur gloves out of doors, they go naked once they enter their snow-houses. Among the others, if any clothing is worn, it is of the simplest description. The Bushmen use a triangular piece of skin, two ends of which are tied round the loins and the third passed between the legs and knotted behind. In addition, in cold weather, a skin 'kaross' is tied round the neck and worn as an outer cloak. The women wear a short apron in front and the older women a larger triangular rear apron as well, while married women wear a large kaross. Both sexes rub their bodies with fat, and powder themselves with 'Buchu'. The women, and sometimes the young men also, paint their bodies, especially before a dance, a widespread custom among primitive peoples of all kinds. Lack of clothing, as pointed out by Porteus, is not to be looked upon as indicating a lack of intelligence. Hunting peoples go naked partly from choice and partly from necessity. For people who are continually on the move and often have to cover great distances in the daily search for food, clothes are a positive handicap. It is a well-known fact that, where peoples accustomed to going naked have, under the white man's influence, been induced to wear clothes, they have shown, from that time onward, an increased susceptibility to pulmonary troubles, a fact which is easily understandable in the light of what was summarized regarding modern medical research in Chapter IV.

(d) What is true of clothes is also largely true of other material possessions. Only those that are of direct usefulness in assisting to capture the food supply are ecologically necessary, though a few other culture accessories may have a certain importance in assisting to promote tribal unity (e.g. musical instruments) or general enjoyment (e.g. the Bushman's pipe). All others, especially if they are so heavy as to be burdensome to carry, must be discarded. The food-gatherer, of necessity and from the commencement, has reached



that stage (to which perhaps mankind as a whole will sooner or later again return) of knowledge that the kind of possession most worth having is that which he can carry inside his head. In those non-material aspects of culture the food-gatherer is by no means so poverty stricken as is sometimes assumed.

(e) One important aspect of general ecology is the way in which various peoples deal with disease or maladjustment to the environment; not that food-gathering types look upon disease in this light, but they do realize that it can on occasion be cured. A knowledge of the medicinal properties of plants seems to go very far back in man's history. Dornan (1925) gives a list of the plants used by Bushmen in their primitive system of medicine, and several of them are known to contain active principles, e.g. *Monsonia ovata*, *Cannabis sativa*, *Solanum nigrum*, *Crotalaria burkeana*, *Datura stramonium*, though others listed by him are probably quite without effects of any kind. The Bushmen are said to apply antidotes for snake bites, but their effectiveness is very dubious. They do, however, undoubtedly have a rather wonderful empiric knowledge of the plants that surround them, and of their more obvious physiological effects on animals, which is the kind of knowledge widespread among this ecological type.

(f) Their relationship with the animal world is even closer, since this is a still more important part of their environment with which, as already explained, they identify themselves so closely. It is not only that they are intimately acquainted with the habits of all forms of wild life, but they regard animals as, in a peculiar sense, their own brothers and sisters, even though, it is true, they are often forced to kill them. This is all part of their religion, which is of a type described by Marett as Pre-Animism. The primitive hunter has a strong feeling for the mysterious external powers of Nature on which he is absolutely dependent. He sees them working all around him in the animal and plant worlds, in the familiar rocks or pools, in the rain or thunder, and through the ghosts of his dead ancestors. The Bushmen, for instance, believe in a supernatural being known as 'Kaang', who is over all things, sends the rain and the game, plenty of food, and good luck

in hunting; but at the same time they identify Kaang with the Praying Mantis. The Kalahari Bushmen call him 'great one', 'Thora', but do not identify him in the same way with the Mantis.

The Bushmen, according to Dornan, look on the soul and body as being two different beings. Everything has another self to the Bushman. When a man is dreaming his other self is talking to him. The Bushmen reverence the memory of their dead and seek to propitiate their ghosts. Magicians seek at times to injure a man by injuring his ghost or other self. The magicians of the Bushmen are true sorcerers, able to cause good or evil, but, except in rain-making, they indulge in little ceremony, and can hardly be reckoned to display more than the early beginnings of priestcraft. The Bushmen also worship the heavenly bodies, sun, moon, and stars, but particularly the moon. The Australian aborigines in their magico-religious beliefs and practices resemble the Bushmen in some respects, differ from them in others. The practice of magic is strongly developed and there is widespread belief in ancestral spirits and reincarnation as well as in some sort of supreme god. Totemism is practically universal, the totem being some plant, animal, or other natural object or phenomenon with which a group or individual is associated in a sort of close mystical union. The belief of the Australian natives that sexual intercourse is unrelated to conception is discussed at length by Porteus, and is regarded as bound up with practically all the magico-religious ideas that the aborigines possess, but at the same time is no proof of lack of common-sense observation of cause and effect. The old men at least are not ignorant of the facts of paternity, according to Basedow, who is quoted by Porteus, as follows: 'The old men believe in the duality of human creation, the spiritual and the material; sexuality is regarded as the stimulus of corporeal reproduction, but the spirit quantity is derived through mystic and abstract influences controlled by a "totem" spirit or Knaninja.'

About the origin and significance of totemism there are still differences of opinion. The American anthropologists, such as Boas, connect it with the idea of the guardian spirit which every individual is supposed to possess. This belief is practi-

cally universal among the hunting tribes of North American Indians. Usually but not always the guardian spirit is an animal. The totem is regarded as a social or clan guardian spirit. Many tribes, e.g. the Dene, possess both clan totems and individual guardians. While the American anthropologists regard the guardian spirit idea as primitive, being part of the simple religion of the hunter, and totemism derivative from it, European writers on the other hand look at things the other way round and generally regard the belief in guardian spirits as being derived from totemism. In any case they both illustrate that mystical feeling of man and his environment being closely united into one whole, which is characteristic of primitive man.

Much of the art of these food-gathering types is probably to be connected with their magic and religion. The paintings of the Bushmen resemble those of Palaeolithic man and usually deal with animals, though occasionally actual occurrences seem to have been portrayed, e.g. dances, fights, or cattle drives. Stow was of the opinion that a certain religious significance also should be attributed to the Bushmen's dances which we have already described. The Bushmen are fond of music, and not only the music itself but also many of their primitive musical instruments (e.g. the Goura, a combined wind and string instrument) are full of interest to the musical historian.

(g) The games of the Bushmen as described by Stow have a certain definite ecological interest and significance. The Nadro or disguise game illustrates their passionate fondness for dressing themselves up and masquerading in the guise of some animal or other. The training game was a man's game designed to show dexterity in the use of the bow and arrow and in avoiding the arrows of one's opponent. Other competitive games have a like value. Children's games among the Bushmen, like those of the adults, usually depended on animal behaviour of one kind or another, e.g. a snake lying in wait at a water-hole to capture its prey. Children's games are always interesting from the ecological standpoint even among civilized peoples and still more so among primitive types of mankind where such games are often surprisingly elaborate both in conception and in execution.

## AUTECOLOGY

From birth to death the relationship of man to his environment undergoes a series of adaptive changes and in all ecological studies these require to be analysed. Space limitations make it impossible to do so in detail for all the examples of food-gatherers, but the following statements generally hold true.

1. *Birth and Infancy.* The women generally are as active in food collecting as the men are in hunting, and though a pregnant woman sometimes has to observe certain food or other tabus, she usually continues her daily work up to the time of the birth of her child. This takes place usually out of doors and delivery is easy, the mother shortly afterwards resuming her duties. The period of suckling of the child is commonly prolonged, up to three or four years in some cases, and for this long period the mother continues to be the most important part of the child's environment. The psychological effect of this is great. Almost without exception food-gatherers are said to be very fond of their children, who in their early years are allowed to do more or less what they please and are thoroughly spoilt. They learn to walk early, yet nevertheless are carried about by their mothers on their food-collecting expeditions. The food eaten by these ecological types is not at all suitable for very young children, but even after they have learned to eat it, they go on demanding the breast. They have developed a degree of consciousness unknown among European children before they are weaned. Weaning marks the end of the infancy stage. As Dr. Richards (1932) has pointed out with regard to the Bantu, weaning is the child's first experience of tabu for they have definitely to be forbidden the breast. Weaning acts as the first barrier between mother and child. Since this first tabu is associated with the mother's breast, Dr. Richards suggests that this may explain much of the extraordinary interest in breasts, as such, among savage peoples generally.

2. *Childhood.* Among hunting peoples young boys and girls go out with their elders on food-collecting expeditions and live their lives in the open, but they are not forced to work hard at any set tasks and their acquaintance with the



outside world is made in a gradual and very natural way. Younger children of both sexes accompany the women, but at a certain age, about eight or nine years on an average, the boys begin to accompany the men, thus becoming still more definitely separated from their mothers. Girls and boys alike are gradually initiated into their life's work of obtaining food. The Bushman father supplies his son with bow and arrows, but, to begin with, the arrows are not poisoned. The child learns to shoot small animals and birds first of all, and when he succeeds in shooting his first small antelope he is given poisoned arrows. When he has learned their use he is allowed to go after big game. Among other food-gathering races a very similar gradual initiation into the everyday work of life is performed. The children's games, already referred to, help considerably in the educational process.

3. *Adolescence*. When this stage is reached, the process of education takes a different turn. It is now no longer a case of the wholly pleasurable process of a healthy youngster developing to the utmost his individual powers of control over nature, and being allowed complete freedom as far as obligations to the community are concerned. The separation from the parents in some cases is signalized by the young people, boys and girls separately, being forced to live by themselves at least for a time. The attainment of puberty marks a very important stage in the life of both boys and girls, and the various puberty rites have received much attention from anthropologists. Those who have passed through the rites successfully become adult members of the community and can be married, though marriage, under certain conditions, may be considerably postponed. It is unnecessary, even if space permitted, to enter into details concerning puberty and initiation rites. They vary considerably among different peoples. Sometimes they are simple, in other cases consist of very severe and prolonged discipline. In general it may be said that the greater the necessity to preserve tribal cohesion and the power of the community as a whole with a corresponding subordination of the individual, the more elaborate and severe the initiation into the status of manhood and womanhood.

Of all the food-gathering races and indeed among all savage

ances there is probably none that has so definitely provided for the proper initiation of their young men into tribal life as the Australian natives. As Porteus has pointed out, their various initiation rites make for tribal unity by bringing about a condition of mutual dependence among totem kins, and they also provide the old men with an opportunity to instruct the young initiated men in the history and traditions of the tribe. The ceremonies are, in the central and northern tribes, elaborate and extend over a long period of time, beginning at puberty and continuing often until the age of thirty. Their severity is a searching test of manhood. No circumstance is neglected that might bring home to the initiated mind the duty of obedience to the will of the elders and the customs of the tribe. 'The child of the aboriginal camp before initiation is a most spoilt individual; but by the time his induction into the tribe is complete there is no more subdued or respectful young man in any community.' 'The lesson may be bitterly, but it is adequately learned.'

Among the Bushmen a girl at her first menstruation is considered to be in a state of tabu. The conclusion of the girls' puberty rites is a ceremonial cleansing. The boys at the time of their puberty are taken in charge in groups by magicians, usually two in number. To begin with the boys are forced to endure very rough usage and are half-starved. Sacred dances play an important part in the initiation rites both of girls and boys, and secrets known only to older people are imparted.

Radcliffe Brown describes initiation ceremonies among the Andamanese. Every boy and girl has to undergo the operation of scarification. A girl is given a special hut where she must sit but is not allowed to lie down. She is not allowed to speak or sleep for twenty-four hours. She sits in the hut for three days but leaves it every morning to bathe in the sea for an hour. Afterwards she is given a new name, her 'flower name'. Initiation for a boy among the coast Andamanese consists of having special incisions made in his back and when these are healed similar cuts are made on his chest. He must abstain for a certain length of time from each one of the more important foods of his community. Afterwards there is a special turtle-eating ceremony during which he

may not lie down or sleep for forty-eight hours, nor eat anything but turtle nor drink anything but water. This is followed by ceremonial singing and dancing. It is unnecessary to quote further examples. It is self-evident that the simpler the social organization the less need there is for prolonged or elaborate initiation into full membership of the adult community.

4. *Marriage.* The ecological importance of marriage from the standpoint of the community is obvious, since it provides for the continuance of the race and among mankind this means more than merely the producing of offspring. It involves the caring for the young for a relatively long period. From the standpoint of the individual which, being autecological, is our main concern at the moment, the importance of marriage is also obvious, since for every married man or woman his or her mate is the most important part of his or her environment. Among the food-gatherers, as we have seen, the sexes, while separated in the everyday work they perform, are otherwise largely on a footing of complete equality. Monogamy is the rule, and polygamy, even when allowed, is not to any very large extent put into practice. Except among the Australians, marriage generally takes place soon after puberty, but, in most cases, the young man must first prove his worth as a successful hunter before his marriage is permitted.

For instance, among the Bushmen he must first shoot some big game animal and present it to the bride's parents.

After marriage, marital fidelity is well maintained—blood vengeance being exercised in the case of adultery. Divorce, however, is usually permissible, barrenness being a common cause.

Among the food-gatherers with relatively simple social organization there are few restrictions regarding who may or may not intermarry, though the marriage of very nearly related persons, e.g. brother and sister, is everywhere apparently avoided. The Bushmen, whose community life was formerly more elaborately organized, while not entirely forbidding marriage within the community, used, as a rule, to practise true exogamy. The elaborate so-called exogamic marriage rules of the Australians are now generally well

known. The simplest arrangement is where a tribe is divided into two 'moieties' and marriage is forbidden among members of the same moiety, but must take place within the tribe between members of different moieties. In other tribes each of these moieties is again divided into two sections making four groups, while in the north and north-west a still further subdivision is in force giving eight divisions for each tribe. In these cases the marriages still take place within the tribe but the number of eligible partners for any one individual is reduced to either one-fourth or one-eighth of the total number. The older view-point explained this intricate system as being due to a desire to avoid in-breeding, though marriage, as has been noted, still takes place within the tribe. The more likely explanation given briefly by Malinowski (who states that the rules of exogamy are very strong, excluding in the majority of tribes a good number of females from all attempts by the males of the forbidden classes and thus tending to increase the security and validity of the marital union) has been elaborated by Porteus as indicated above. It is regarded as a socially unifying expedient. These facts concerning marriage are all ecologically significant, but the numerous details regarding marriage ceremonies among savage peoples, with which the literature of Anthropology deals at considerable length, are not so important and need not be described here, though were the subject to be followed out in all its detailed aspects, an ecological meaning could no doubt be discovered for most of them.

5. *Adult Life.* While emphasis has rightly been laid on the comparative equality of all adult members of the community and the absence of stratification or social distinctions, at the same time, qualities which make for leadership receive due recognition. Power, in a very natural way, falls into the hands of the abler, wiser men and this usually, but not always, means the older, more experienced men. Exceptional ability may place a younger man in a position of authority, though this seldom happens because the kind of knowledge and experience which enables a food-gatherer to make the very most of his environment takes a long time to be acquired. Where social organization is more complex it is not only a knowledge of Nature and her ways that



is demanded but a knowledge of tribal customs and traditions as well, a knowledge of ceremonial and of mythology, magic, and religion. During his life as an adult member of the community, the primitive food-gatherer, like all other types of mankind, if he is to be successful, contented, and happy, must fit into the ways of communal life. A few rebel and receive fitting punishment as happens everywhere else. Extremely few succeed in altering the established order of things to any extent, for the culture patterns, simple as they are for most of the food-gathering communities, have lasted a very long time. It is only in recent times, through contact with other races and cultures, that changes have begun to be forced on them from without, and the fate of the Tasmanians has demonstrated how, if such changes are too sudden or too drastic, the final result is a complete obliteration of people and culture alike.

6. *Death and Burial.* The belief that existence after death continues in one form or another seems to be more or less universal among primitive peoples; indeed, his burial customs have been taken by some to indicate that it even formed part of the beliefs of Neanderthal Man. It is well, however, to point out that the fact that a dead person's possessions are buried with him does not necessarily imply a belief in a future life. It may be due to the fact that people shrink from making any further use of the possessions of those who were dear to them when alive. Stow, in describing the curious custom of cutting off the little finger, which he says used to be almost universal among the Bushmen tribes, states that 'the operation was performed with a sharp stone and they believed by this act of self-mutilation they secured to themselves a long career of feasting after death'. Others believed that it ensured them a safe journey to a place called 'too'ga, to which, after death, they will all go. The same custom of amputating fingers (though not necessarily the same beliefs) was common also among the Palaeolithic people of Aurignacian Age in Europe, as is shown by numerous cave paintings. As regards the Bushmen, Shapira gives other details of a variety of interesting beliefs linking up death with the phenomena of Nature, illustrating once more the intimate way in which the Bushman identifies himself with his environment. Dead

people may appear to their friends as apparitions that are sometimes feared, sometimes welcomed. The Australian aborigines believe in the vague incarnations of the ghosts of their ancestors who lived in the remote past. These ghosts are associated with their sacred objects known as *churinga*, pieces of carved stone or wood that are regarded as possessing certain powers which help in making for the success of the tribe in its hunting and food-collecting and everything else.

The burial customs of the food-gathering peoples vary considerably. Some, e.g. the Veddahs of Ceylon, whose whole religion consists of the cult of the dead, leave their dead in a cave which is then deserted. The African pygmies bury their dead in the ground. The Andamanese decorate the body of the dead person with white clay and red paint, and bury it in a contracted position, with a few objects belonging to the deceased, either in a grave or on a platform of sticks erected in a tree. Among the Bushmen the corpse is often buried with all his former possessions somewhere near his hut, lying on his side in a sleeping position. Skeletons of former Bushmen are often found in caves. Anointing with red Buchu powder, mixed with fat, commonly precedes burial. Many of the former Bushmen used to heap stones above the graves of the dead. The Bushmen used often to abandon old people who were unable to keep up with the movements of the hunting band—a procedure brought about by grim ecological necessity. Others, e.g. the Eskimo, used to do the same. Among the Australians the modes of disposal of their dead are very varied. Sometimes the bodies are simply abandoned, occasionally they are eaten, sometimes burned, sometimes placed on a platform built in a tree, sometimes dried and smoked and thus partially mummified, but most usually buried in a carefully prepared grave which, in some cases, is at the end of a gallery leading from the bottom of a shaft, the top of which is covered with a mound recalling the burial places of Neolithic man. Spears and weapons and his other property are commonly placed with the dead man in his grave.

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## IX

### THE ECOLOGY OF PLANT CULTIVATORS

Introductory—The Beginnings of Plant Cultivation—The Chief Food Plants of the World—Types of Primitive Cultivators—Their Environment and Responses—Religion and Magic—General Ecological Characteristics and Culture—Autecology—Bibliography.

#### INTRODUCTORY: THE BEGINNINGS OF PLANT CULTIVATION

WHILE primitive man has, through his close contact with his unchanged environment, been able to exercise a certain degree of control over it, he has never made any very prolonged or consistent effort to tame Nature, and provide for his needs, not merely from day to day, but for some time ahead, by utilizing plants and animals under domestication. The fact that, as we have seen, the dog at an early stage entered into a sort of partnership with man can hardly be considered an exception to this rule, for the dog from the beginning was not used as food, but rather as a help in obtaining food.

There is good evidence for supposing that the cultivation of plants preceded the true domestication of animals, though the pig apparently was domesticated very early. It is worth noting in passing that the wild pig is not a grass-eating animal, but lives on roots, bulbs, tubers, corms, &c., the type of plant material most collected by the women of food-gathering peoples.

While there must always be much uncertainty regarding the beginnings of plant cultivation, it is obvious that it is no great step from collecting plant roots to transplanting them and finally to cultivating them.

Some of the food-gatherers, e.g. Western Australian aborigines and the Veddahs of Ceylon, after the women have dug up yams, replace the leafy portion or a portion of the root in the soil so that it may grow again. Some of the primitive Malay tribes have the custom of planting the seeds of edible fruits, which they have eaten, near their settlements. These are valuable facts, since they give us a hint as to the probable



course of events in the beginnings of the stage of transition, on the part of mankind, from food-collecting to food-growing. It probably began under a tropical or sub-tropical environment. The earliest method pursued was cultivation by the hoe, and the process of cultivation was probably assisted by burning down the forest, so as to provide suitable garden-sites—the method still followed all over the equatorial regions of the globe. It has had profound results in changing the vegetation over enormous areas, and even in altering climate as well. It is specially applicable to regions where the natural climax vegetation is bush, jungle, or forest but not to grassland regions, which, as we have seen, have only begun to be brought under cultivation in recent times. The soil, enriched by the ashes, is tilled as a garden and crops are grown for two or three years in succession, until the soil becomes exhausted, when it is discovered that the process requires to be repeated on a new site. Brunhes (1920) has named it the 'forest devastation' method of plant cultivation.

The next stage involves distinctly improved methods and, therefore, we may suppose, came later. It involves a more distinct appreciation of the importance of water to plant life. It is confined to the great river valleys and to their tributaries, and can be seen in operation to-day, in its simplest form, in the valley of the Zambesi, where advantage is taken of the natural irrigation due to the seasonal floods, when the river overflows its banks and extensive areas are inundated. As soon as the river subsides, the natives plant their crops in the mud all along the river's banks. Tributary streams, which often descend somewhat steeply, are likewise swollen to large dimensions during the rainy season. When the rains cease they rapidly subside, but numerous stagnant pools and swamps remain along their courses. The natives utilize these for growing crops wherever possible.

This is the type of plant cultivation which was developed, along all the great rivers from the Nile to the Indus and beyond to China, at the dawn of civilization, about which so much has been written. But by the time it came fully into operation cereal crops were probably being cultivated, and grain cultivation, as we have indicated, is not so simple nor so primitive as the planting of roots in gardens. The seeds

of a kind of millet, *Echinochloa colona*, known as 'Shama Millet' have been found in the stomachs of bodies, disinterred from the graves of upper Egypt, dating from pre-dynastic times. It is still grown in India as a cereal, as is another species of the genus, *E. frumentacea*. A third species, *E. pyramidalis*, is used as a cereal by African races. Both *E. colona* and *E. pyramidalis* enter into the 'Sudd' formation of the Nile and other African rivers. The genus *Echinochloa* is allied to *Panicum*, under which it used to be included. It is not, of course, safe to assume that because grass seeds are found to have been eaten, they must necessarily have been cultivated. We have already seen that the Bushmen used to collect large quantities of the seeds of wild grasses and store them for winter use. In Abyssinia the seeds of the wild *Eragrostis tef*, 'Teff', now cultivated elsewhere, are collected by the natives, made into flour and baked into bread. The use made of the Indian wild rice in America was referred to in Chapter VI. Until quite recent times its grain was collected, to the extent of thousands of bushels annually, by native Indian women. Hitchcock and Chase (1931) record that the women used to tie together the heads of as many plants as could be gathered in the arms. These tied heads were left to ripen, when the women returned and, holding the tied heads over their canoes, beat out the grain. The Sudd of the Nile might be treated similarly. Whether we accept the evidence that this particular millet was cultivated by those pre-dynastic Egyptians or not, the evidence that grain cultivation was general, during that early period, among all the peoples of the Painted Pottery and other Neolithic cultures, is overwhelming. There were several varieties, both of barley and of wheat, but the origin of cultivated plants will be dealt with separately.

River valley cultivation, by means of natural irrigation, was further improved upon, as soon as man learned how to control the water supply by artificial means, how to extend it by means of furrows, or to confine it and conserve it in artificial dams. River valley cultivation was followed by terrace cultivation. Hocart (1933) has pointed out that this method is pursued in the cultivation of the taro, a root, and that the obvious inference would seem to be that this form of irrigation is older than grain, though he adds that it is

just possible that a grain-growing people introduced irrigation into the South Seas without the grain. He also points out that for rice (with the exception of 'hill-paddy') careful irrigation is a necessity, and its cultivation could only follow, therefore, on a very long experience of irrigation.

The next great step in the cultivation of plants took place when the assistance of domestic animals was made use of, and the hoe gave way to the plough. This marked the passage from the so-called 'lower agriculture' to the 'higher', though the former would be better designated horticulture since it was the garden rather than the field that was tilled. Plough agriculture, though it developed early in Asia, Europe, and North Africa, has not until very recent times, and as a result of European colonization, been extended to other parts of the world. Among the Negro or Bantu races of Africa, except in Basutoland, it is hardly practised even to this day. In all parts of the area where it first was developed, from China to Europe, the ox was apparently the animal made use of to haul the plough. Primitive plant cultivation (like food-collecting as distinct from hunting) was, as we have seen, mainly the work of women, but plough agriculture, since it involves the use of domestic animals, from the commencement made the growing of plants the concern of the men as well, a fact which led to profound social changes throughout the great region mentioned. Without doubt this had a great deal to do with the building up of the higher types of civilization. However, before we go on to discuss the changes in social organization resulting from the gradual development of plant cultivation through all its stages, it will be well to devote some more attention, though very briefly, to the plants that are made use of.

#### THE CHIEF FOOD PLANTS OF THE WORLD

These fall into two rather distinct ecological classes, the tropical-sub-tropical on the one hand and the temperate on the other. The former are more or less all easily injured by frosts, the latter are not so susceptible. Among the most important non-cereal tropical or sub-tropical food plants are bananas and plantains, yams, manioc or cassava, bread-fruit, taro, and the date, coco-nut and sago palms. Corre-

sponding to these in temperate regions are potatoes, cabbages, carrots, &c., and the legumes (peas, beans, lentils). The family of the grasses, however, is more important for man than all the rest put together, and this family also falls into the same two fairly distinct ecological classes, tropical or sub-tropical, and temperate, though a few cultivated cereals are somewhat intermediate between the two.

The tropical-sub-tropical economic grasses include various forms of millet, some of which have penetrated into cooler regions. *Panicum miliaceum* (Proso, Hog millet or Broom-corn millet) is probably the 'Miliun' of the Romans, from which the name millet is derived, though the name is also applied to other grasses (*Setaria Italica*, 'Italian millet', and *Pennisetum glaucum*, 'Pearl millet'). The millets have been cultivated from very remote times. The allied genus *Echinochloa* has already been referred to. The genus *Sorghum* has about thirty species, and numerous additional varieties, that are grown for food in various parts of the tropics, especially in Africa, where, before the introduction of the maize plant, they formed the chief grain crops of all the various native races. The fact that such a large number of cultivated forms are botanically regarded as specifically distinct, and not merely as races or varieties of one or two species, is a rather strong argument for considering the cultivation of the Sorghums as being very ancient, even though there is no such definite evidence, as is available for *Echinochloa colona*, that it was used by prehistoric peoples. The rice (*Oryza sativa*) is a semi-aquatic grass of tropical affinities, at the present time the main food supply of Eastern peoples. It is known to have been cultivated for at least five thousand years. A variety of it, mountain rice, can be grown under much drier conditions. As regards the cultivated plants of temperate regions, the barley has been recovered from pre-dynastic graves in Egypt, and has often on this evidence been regarded as the first cereal to be cultivated. Wild barley (*Hordeum spontaneum*) from which the two-rowed cultivated barleys are supposed to have been derived, grows wild from the Caucasus to Afghanistan. Barley has also been recovered from the Lake dwellings of Switzerland of Neolithic age. The wheat, in all its innumerable cultivated races, is referred to only two dis-



inct wild species, *Triticum Aegilopoides*, 'Wild small spelt', from which *T. monococcum*, 'einkorn', has been derived, and *T. dicoccoides*, 'wild emmer', from which 'emmer', 'macaroni wheat', 'Polish wheat', 'common bread wheat', 'spelt', and many other varieties have come. The former grows wild from Asia Minor to Persia and Syria, the latter apparently only from South Syria and Palestine.

Other temperate cereals, such as oats and rye, have apparently had a less ancient history as cultivated plants. The evidence regarding the history of cultivated plants, presented by archaeological research, is at best fragmentary and unsatisfactory. Seeds alone are likely to be preserved, and, from their nature, roots or other edible plant organs cannot be expected to be found. There is, however, another and purely botanical line of attack on this important problem. Professor N. I. Vavilov has recently given an account of Russian work on 'The World Centres of the Origin of Agriculture and the Soil Map of the World'.<sup>1</sup> During the last decade or so, under his guidance, the Institute of Applied Botany has devoted considerable attention to the problem of the origin of cultivated plants, and has come to the conclusion that the home of a cultivated plant is the region where the primary varietal potential of the given plant is concentrated. Working on this assumption, Vavilov and his co-workers have established six principal world centres of origin for cultivated crop plants which, at the same time, are regarded as the probable centres of origin of agriculture, having come into existence, independently, at different times, and at different places.

The six world centres are: (1) South-western Asia including North-western India, the principal centre, where the forms of many important cereals, e.g. soft wheats and rye, as well as peas, beans, lentils, turnips, carrots, and forage plants such as alfalfa have originated. This is also the world centre for the majority of fruit trees and shrubs, e.g. grapes, pear, apple, apricot, pomegranate, quince, sweet cherry, &c.; (2) South-Eastern Asia, chiefly Eastern and Central China, the home of soya-bean, millet, citrus fruits, and many vegetables; (3) North-eastern India, Indo-China, and Burmah, where

<sup>1</sup> See *Report of the Second International Congress of Soil-Science*, pp. 80-5, 1932.

rice and other tropical crops first came into cultivation; (4) Mediterranean Region, where the agriculture of ancient peoples was concentrated and the olive-tree, fig-tree, carob-tree, and some forage crops were first grown; (5) Abyssinia, the home of durum wheats, barley, teff, &c.; (6) Central and Southern America.

It is pointed out by Vavilov that these regions lie chiefly in the mountain or foot-hill zones. The centres of the origin of crop plants, and at the same time of primitive agriculture, lie close to the most important mountain regions of the world, at the foot of the Himalaya, Hindu-Kush, in the mountain massifs of China, in the Cordilleras, and the mountain regions of East Africa. The views of some authors that the beginnings of agriculture ought to be sought in Syria and Palestine, Vavilov says, are entirely erroneous and do not take into consideration the present level of our botanico-agronomical knowledge, which definitely points to the fact that agriculture has originated in different countries. It is also noteworthy that the centres named were situated far away from the regions of the best soils. The chief fertile regions of the earth, with chernozem soils (soils similar to the 'black earths' of Russia), have begun to be utilized only in recent times, i.e. during the last two centuries. Agriculture, he concludes, still holds great possibilities, since, up to recent times, the choice of the cultivated plants was accidental rather than planned.

#### TYPES OF PRIMITIVE CULTIVATORS

Since practically all the peoples of the world are engaged in cultivating plants, it would clearly serve no good purpose to endeavour to enumerate them all, but a few facts regarding the different types of ecological differentiation exhibited by the simplest of them may first of all be noted. The most primitive type of hoe culture is still pursued right round the tropical belt, and particularly in Africa and the islands of the Pacific, where the ecology of several examples has been intensively studied, especially by the school of functional anthropologists. It is an interesting fact, as already noted, that even where domestic animals such as cattle and also horses are kept, as among the Negro peoples of Africa, these are

not, with one or two exceptions, used for ploughing. Agriculture remains mostly the work of the women, who hoe the fields and plant the crops. The men, however, co-operate in clearing the forest sites, which are utilized. In other parts of the world, e.g. in New Guinea, while women practise hoe-culture, the men mostly continue as hunters. This was the case in America, among the Indian tribes, in pre-Columbian days, and still continues in many places. The Maya mode of agriculture, for instance, to-day probably remains very similar to what it was during the first millennium B.C., when they first commenced to build up their ancient civilization. Their agricultural methods are very much the same as those used by the African natives.

They cut down the woody 'bush' vegetation, banding together, in groups of a score or so, to assist one another in doing so. This practice has persisted from the remote past when, with their stone axes, they cut down the trees, which they had previously 'ring-barked' so as to kill them. The felled bush is allowed to dry completely and then burned. After the first shower of rain, about May, the maize is planted, by making holes at intervals and dropping a few grains in each. The ripe cobs are gathered about October. In ancient times, religious ceremonies took place before the work was commenced, and after harvesting the crop. A new area is usually cleared and planted each year. It is allowed to lie fallow for from two to six years, when it is re-planted, but gradually, after each re-planting, the soil gets poorer until it becomes useless for agricultural purposes.

Game, hunted by the ancient Maya with the bow and arrow, with the aid of dogs, and by means of traps, formed the chief source of additional food; the modern representatives of the Maya are also hunters. The ancient Maya were also fishermen around the coasts, and they had domesticated the bee. Bee-keeping was an important industry among them. From the honey they prepared a wine, of which they consumed large quantities at their feasts.

Huntingdon (1914) correlates the rise and fall of the ancient Maya civilization with the climatic cycles that have been established, based on the careful measurements of the year rings in the wood of the Sequoia trees of California.

During the first period the climate was dry and bracing, and the bush could be kept down. About the year A.D. 450 the climate became warmer and moister, and the Maya civilization degenerated. About a hundred years later the climate again became drier; then the warm moist conditions returned, to be followed by another dry period. The dry periods corresponded with progress in civilization, the wet periods with retrogression, since, with their primitive implements, the Maya found themselves unable to cope with Nature's luxuriance.

From the multitude of possible examples that could be described one or two others may be selected to illustrate different points. The Pelew Islanders, according to Kubarry (1885) (as quoted by Frazer), are a branch of Micronesian stock, and are divided into a series of exogamous clans or families, with descent in the female line. The women enjoy complete freedom and equality with the men and, indeed, politically and socially they tend to be superior. The staple food of the Pelew Islanders is the taro, and the cultivation of it is the work of the women alone. The women regard this as their privilege and not as a sign of inferiority in any respect.

'The richest woman of the village looks with pride on her taro patch, and although she has female followers enough to allow her merely to superintend the work, without taking part in it, she nevertheless prefers to lay aside her fine apron, and betakes herself to the deep mire, clad in a small apron that hardly hides her nakedness, with a little mat on her back to protect her from the burning heat of the sun, with a shade of banana leaves for her eyes. There, dripping with sweat in the burning sun and coated with mud to the hips and over the elbows, she toils to set the younger women a good example.'

The Pelew Island women are entitled 'Mothers of the Land' or 'Mothers of the Clan'. Some of them are regarded as the wives of gods, and act as their oracular mouthpieces.

Another example may be chosen from Asia. The Ainu are a primitive people that live partly in the northern island of Japan and partly in Saghalien. Racially they differ from other Asiatic people, being probably the relics of an ancient mesocephalic group of white people. They have a great profusion of black, wavy hair and are like Europeans also in the



colour of their eyes and skin. Buxton (1924) lays emphasis on the fact that they are developing from the hunting stage to that of agriculture, a process that is being hurried by the Japanese.

A generation ago they lived mainly by hunting the bear, deer, and other animals, and by fishing. These occupations were pursued by the men and, side by side with it, the women practised agriculture. Now agriculture is of the greatest importance. The principal crops are barley, millet, beans, potatoes, and peas. The women get up before sunrise and work hard all day in their gardens. They cultivate each garden for two or three years and then let it go to waste. They reap their cereal crops by pinching off the ears with a bit of shell. They also use wild plants, collecting chestnuts, roots, &c., in autumn. Though they have only so recently adopted agriculture, their villages are clearly meant to be permanent. Though their houses are fairly complex structures, they build the roof first, showing that the origin of them was probably the tent.

A final example is deserving of somewhat more detailed reference. The important work of Malinowski on the Trobriand Islanders of the Melanesian Archipelago, east of New Guinea, not only has served as a model for other workers on the same lines, but in itself has thrown a flood of light on the general economic activities of the primitive people with which it deals. It is interesting, at the outset, to note that, in this case, plant cultivation is the work of men, though women co-operate. The Trobriand Islanders are matrilineal. A child belongs to the clan and village community of its mother, and wealth and social position are inherited, not from father to son, but from maternal uncle to nephew. Sociologically the village is the unit, ruled over by a chief. The village community exploit jointly their garden lands, perform ceremonies, wage warfare, undertake trading expeditions, sail in canoes, together as one group. In tribal life the position of the women is high. They are given complete freedom and the married woman retains a large measure of independence. Half the native's working life is spent in his garden, where it is the privilege—it is regarded as a privilege as well as a duty—for the woman to assist with some of the work. Each

year about one-quarter to one-fifth of the total area is under cultivation as gardens and these are well tended and present a pleasant change from the monotony of the scrub. The staple produce grown is the yam, but they grow taro and sugar cane as well, and also use the mango, bread-fruit, coconut, &c. They also eat fish and meat (in the form of the flesh of the pig). Malinowski lays stress on the fact that the native is not a happy-go-lucky, lazy child of nature, but can and, under circumstances, does work hard and work systematically, with endurance and purpose, nor does he wait till he is pressed to work by his immediate needs. The natives produce much more than they actually require, and in any average year they harvest twice as much as they can eat. Before the advent of the Europeans the surplus was regularly allowed to rot. The natives accumulate foodstuffs, not only for purposes of utility, but because they like to display their possessions in food. They vie with one another as to who can make the best display, but, wisely, they do not try to compete with the chief. Much time and labour is also given up to aesthetic purposes, to making the gardens tidy, clean, cleared of all debris, with fine solid fences and strong, big yam-poles. They push their conscientiousness far beyond the limit of what is purely necessary.

Magic is very important in connexion with garden work, the garden Magician, next to the Chief and Sorcerer, being the most important man in the village. He has to perform all sorts of ceremonies, at each stage of the work, and after the yams are harvested, but before they are stored, the magic called *vilamalya* is performed to make the food last long. When the tubers are taken out of the ground they are first displayed in the gardens in heaps with the biggest yams outside. They are kept there for a fortnight or so and much admired by visiting parties. Then they are transported into the village. The garden magician, according to native ideas, controls both the work of man and the forces of nature. He acts directly as supervisor of the gardening work, sees to it that people do things properly and at the right time. A good garden worker in the Trobriands derives a direct prestige from the amount of labour he can do and the size of the garden he can till. The title *tokwaybagula*, which means

'good' or 'efficient gardener', is bestowed with discrimination and borne with pride. Most important of all is the fact that almost all the fruits of his work and certainly all the surplus which he can achieve by extra efforts goes, not to the man himself, but to his relatives-in-law (his sister's or mother's husband and family) and to the chief. The Trobriand Islander works to a very large extent for the sake of the work itself, not guided primarily by a desire to satisfy his wants, but by a complex set of traditional forces, duties and obligations, beliefs in magic, social ambitions and vanities. And Malinowski adds that all that has been said about the Trobrianders applies also to the neighbouring tribes.

Malinowski says that, instead of acting, as is so often supposed, as a cold egotist searching for food or catering only for his own household, the Trobriander, on the contrary, exhibits to the fullest extent the fundamental human impulse to display, to share, to bestow. He shows a deep tendency to create social ties through exchange of gifts. To give for the sake of giving is a feature of all primitive societies. The important part which magic plays in the primitive agriculture of these islanders is not the least important point emphasized by Malinowski. Magic is also deemed equally necessary by them to ensure success in fishing and, finally, for the very interesting institution known as *kula*, analysed and described in great detail by Malinowski. It consists of a ceremonial exchange of two distinct manufactured articles between the different tribes inhabiting a wide ring of islands. The two articles are (*a*) necklaces of red shell called *soulava* which circulate around the ring in a clockwise direction, and (*b*) bracelets or armlets of white shell called *mwali*, which circulate in the opposite direction. Each of these articles, as it travels in its own direction, meets on its way articles of the other class and is constantly being exchanged for them. Every movement of the *kula* articles, every detail of the transactions is fixed and regulated by a set of traditional rules and conventions and some acts of the *kula* are accompanied by elaborate ritual and public ceremonies. These articles are not to be regarded as a kind of currency; they bear no relationship to money or to equivalents in the shape of goods. There is, however, a regular

trade which consists of barter pure and simple; each side acquires what is needed and gives away a less useful article, e.g. manufactured wooden dishes for coco-nuts or coco-nuts for betel nuts, fish for yams, and so on. This kind of barter is called *gimwali* and requires no ceremonial or magic.

These accounts at once make clear the very great ecological difference between those dealt with in the last chapter, the food-gatherers, and even the most primitive of plant cultivators. With further progress in agricultural methods and particularly when the plough began to be used the differences became still more strongly marked. But once more the proper ecological analysis of the process can best be undertaken by paying attention to the different terms of the fundamental biological triad.

#### THEIR ENVIRONMENTS AND RESPONSES

While the new environments, which were to a large extent created by man himself, as soon as he began to cultivate plants, were the result of a very gradual process of development, some of the results, no doubt, began to be apparent almost from the beginning. At the same time, the old environmental responses and relationships continued. As we have seen, even to-day, in certain cases, the menfolk continue as hunters. Men are always ready even among the most highly civilized communities to go back to hunting or fishing, at least temporarily and as a relaxation. The most important features of the environment of food-producing peoples can best be emphasized if we compare them with the unchanged environments of the food-gatherers.

First of all the effect of food providing is to make possible a great increase in the size and density of the population occupying any given area. Other results immediately follow. The social environment becomes more complex, there is room for a system of division of labour, social inequalities and gradations are brought about, the needs of the individual become more complex, as the opportunity of gratifying his desires for luxuries of one kind or another increases, and different members of the community specialize in one direction or another so as to supply all that is wanted. While the social environment becomes more and more important the



non-social environment recedes somewhat and no longer occupies quite the same intimate relationship to man and his activities as before. Yet some aspects of it actually tend to increase in importance. While the food-gatherer was always so intimately in touch with wild nature as to feel himself completely at one with and part of it, the primitive food-grower, in a somewhat more detached way, began to observe how dependent plants are and, therefore, indirectly he himself is, on changes in the seasons, on the alternation between wet and dry or warm and cold seasons, on rainfall and the earth itself, the mother and producer, in a word all the factors which are necessary for success in his new work. How he meets the new situation constitutes the middle functional term of our triad. There have been general responses in himself, in his mental outlook and, to some extent, even in his physiological behaviour, and there have been profound changes in his culture. At the same time it should be remembered that this new culture was superposed on the old cultural heritage, which man had slowly built up for himself during the hundreds of thousands of years of his food-gathering existence. This culture was not forgotten by him. It was merely altered, ever so gradually, to meet the new situation. In dealing with this new ecological type, therefore, if we were to follow exactly the same line of thought and arrangement of the facts as in the last chapter, it would result in a somewhat unsatisfactory presentation. It is not now merely a question of the reactions and responses of a primitive ecological type to a simple unchanged environment and the gradual building up of a culture. It is a case of extensive transformations of already developed cultures.

The change came first, as we have seen, in the women's culture—the women food-collectors became the first plant cultivators, and the men, apart from lending some assistance in preparing the garden, continued as hunters. This is now generally accepted as affording the best explanation of why, among primitive plant cultivators, the system of descent is generally of the matrilineal type, i.e. kinship is reckoned in the female line. This is the case even when the government of the community remains in the hands of the men, but in certain extreme cases (e.g. among the warlike Iroquois of

North America) actually the older women elect the chiefs. While in some cases, e.g. in the Indian Archipelago (Celebes, Ceram, Borneo, Mias, and New Guinea), the work of cultivation is shared between the two sexes, and occasionally the men do most of the work themselves, among the great majority of primitive cultivators there is a widespread, deep-rooted belief that, since women bear the children, they are likely to be more successful in raising crops. The women regard this work as their right and privilege—a source for them of continual interest and pleasure. Among the Baganda, for instance, according to Roscoe, princesses and peasant women alike look upon cultivation as their special work; the garden, with its produce, is essentially the wife's domain, and she would, under no circumstances, allow her husband to do any digging or sowing in it. No woman would remain with a man who did not give her a garden and a hoe to dig it with; if these were denied her she would seek an early opportunity to escape from her husband and return to her relatives to complain of her treatment, and to obtain justice or a divorce.

To understand the resulting complexity, not only in social organization but in all the general ecological reactions and in cultural development, it is necessary to explain at least in outline how the vague religious beliefs of the food-gatherers were gradually modified into something widely different from that described in the last chapter, until it became a very highly organized religious system—a true peasant religion.

#### RELIGION AND MAGIC

Though the tendency in modern Anthropology (Malinowski, Driberg, and others) seems to be to draw a distinction functionally between religion and magic, there is no doubt that religious theory has always tended to become blended with magical practices. Primitive men have their chants and spells and most modern religions have retained some degree of ritual. However, it may make for clarity if we consider first of all and by themselves religious beliefs of primitive cultivators. The most fundamental, and practically universal one, is that which regards the earth as the mother of all living things—the great female principle of Nature. There would seem to have been in the minds of the first cultivators a

certain tendency to connect the Earth mother with earlier religious ideas of animal guardian spirits, for she is also represented in animal form, or as the goddess of the wild animal life. Associated with her is her divine son and lover, being the personification of plant life, who again is represented in animal form by the pig and the bull. As Hocart (1933) has pointed out, primitive man did not look upon the sowing of seed and the process of germination, which results in a new crop, in the same way as we do. Even now we use the Latin word *semen* for seed and for the fertilizing secretion of the male, though the latter is scientifically spermatozoa and not seed. Primitive man regarded the sowing of seed of plants as a process of impregnating the mother earth by means of a male fertilizing agent which resulted in renewed birth. Moreover both the seed that is sown and the seminal fluid of the male were regarded by primitive man as analogous, functionally, to the rain which causes the crops to grow. Once the significance of this view-point is grasped, the understanding of all the seeming complexity of the primitive religions of agricultural peoples becomes relatively a simple matter.

The mother goddess and her consort have received many names, but their attributes remain more or less the same; Ishtar or Innini and Tammuz in ancient Mesopotamia, Isis and Osiris in Egypt, Cybele or Ma and Attis in Anatolia and later in Rome where their worship was introduced in 204 B.C. The worship of Adonis was practised in Babylonia and Syria and the Greeks borrowed it. By decree of Zeus, Adonis had to abide with Persephone, queen of the nether world, for one part of the year (the winter when vegetation dies down), and with Aphrodite, goddess of love, in the upper world for the other part.

During the Neolithic period, agriculturalists brought with them into Europe, according to Dawson (1933), the worship of the mother goddess, as shown by the numerous clay figures of women, so characteristic of the painted-pottery cultures. Even to-day we find abundant traces of this religion left in the pre-Christian mythology of Central and Northern Europe, in the form of numerous harvest customs, in such forms as the Corn mother, Corn maiden, or Corn spirit, &c., while in India, as Dawson also points out, 'the religion of

Buddha has vanished from the land of its birth, but the Mother goddess still reigns supreme, alike among the primitive tribes of the jungle and the civilized and educated population of Bengal'. Tammuz, Osiris, Attis, or Adonis, whatever his name may have been, was commonly personated by priestly kings or others, who were sometimes put to death as the vegetation god annually dies. Human sacrifices to the earth mother or corn spirit were a practice that became very widespread from Africa through Asia to America where among the ancient Maya blood sacrifices were common. Worshippers used to shed their own blood in honour of the gods, but in addition large numbers of victims were sacrificed, though not so many as among the Aztecs where, it is said, 70,000 victims were, on one occasion, sacrificed at the dedication of a temple. The Maya consumed the flesh of the victims at a sort of communion service. In addition to human beings, they also offered all kinds of animals, birds, and fruits to their gods.

The close analogy between what primitive cultivators regarded as the impregnating of mother earth and the sexual reproducing of their own offspring led to other practices which were regarded in a religious light, e.g. periods of sexual licence and sacred prostitution—the sacred prostitutes being looked on as the wives of the god of vegetation.

Magic is distinct from, and at the same time very closely intertwined with, religion. We have seen this inter-relationship even among the Bushmen and other primitive food-gatherers. The Australian natives in their vague beliefs regarding the mysterious external forces of Nature and the incarnation of the ghosts of their ancestors associate these with the sacred *churinga* which possess a certain power or *mana* which is regarded as helping the tribe or individual members of it in various ways. The word *mana* is connected with Melanesian magic where it was first studied and described by R. H. Codrington (1890). It has its counterpart in many other languages and among many other peoples, but the term is now one in general use among anthropologists and students of primitive psychology. It comprises the ideas of a power, a cause, a force, a quality, a substance, a medicine, or an atmosphere. Hubert and Mauss (1909) have given a



very full analysis of its meaning. (See also Murphy (1927) and Allier (1929).)

'*Mana* is alike natural and supernatural, since it is spread throughout the whole sensible world to which it is alien, but in which it resides.' (Hubert and Mauss.)

'It is the essence of that truly primitive type of rudimentary religion, known as Fetishism. . . .'

'In civilized society there is a reversion to type in the form of a half serious belief in luck, charms, amulets, and mascots. . . .'

'On the other hand, let the primitive mind develop in mental power and *mana* acquires a deeper integration and richer differentiation, becomes unified into the idea of a spirit or soul from which by way of animism all religions may be said to be derived.' (Murphy, 1927.)

To describe fully all the forms and ramifications of magic among primitive peoples would take us too far. For the uncivilized man it creates a world governed by the unseen. All occurrences are capable of being influenced by occult powers. These are capable, in turn, of being assisted or neutralized by charms, spells, enchantments, by the general power of fetishes. In all savage societies the wizard or witch-doctor, the specialist in magic, is all-powerful. But belief in magic, as we are all aware, is by no means confined to savages. Most of us have our superstitions, and the burning of witches in European countries was only a matter of yesterday.

A description of the men who practise magic, the magicians, witch-doctors, or sorcerers, will be undertaken in somewhat greater detail at a later stage, when a more definite attempt is made to classify mankind ecologically, but as regards the thing itself, Malinowski (1922), in his detailed account of the magic of the Trobriand Islanders, lays emphasis on the fact that magic is never invented. It is an inherent power of man over those things which vitally affect him, a power always handed over through tradition. About the beginnings of magic, the Trobrianders know as little, and are occupied as little, as about the beginnings of the world.

Malinowski also points out that magic all the world over, however rudimentary or developed it may be, is not all one piece, but represents three essential aspects, the formula or spell, the rite, and the condition of the performer. In the

Trobriands the spell is by far the most important constituent of magic. It is the part which is kept secret and is known only to the esoteric circle of practitioners. The nature of the rite is always public property. The formulae are often very elaborate, the rites very simple. Spells may be uttered directly without concomitant rites, or the spells may be accompanied by simple rites of impregnation, or by a rite of transference. Spells may also be accompanied by offerings and invocations. As to the condition of the performer, Malinowski says (p. 140), 'His belly is a tabernacle of magical force. Such a privilege carries its dangers and obligations. It is clear you cannot stuff foreign matter indiscriminately into a place where extremely valuable possessions are kept. Food restrictions therefore become imperative.' Other tabus are permanent, e.g. 'the man who knows *Kay-ga'u* magic is not allowed to eat while children make noises'. Malinowski also deals with the 'systems of magic' and the distinction between systematic and independent magical rites and formulae, but for further details his work should be consulted.

Murphy points out that primitive intelligence is easily tired and falls back on various ways of escaping fatigue: (1) by change of thought, (2) by doing something, (3) by doing the same thing over and over again, i.e. custom. As it is easier to slip downward on the slope of evolution than to strive upward, man finds rest from the fatigue of mental effort in muscular movement, and in doing things which call for the minimum of thought. Here is much of the charm of ritual and magic, as well as the playing of games, sport, &c. In the ordeal there is a simple and, to the savage mind, extraordinarily effective action which obviates the weighing of evidence, an impossible task to such a mind. Imitative magic is a practical method of increasing the food supply and adding the pleasure of drama, without the hard thinking called for by better methods or new inventions.

One more example of the part played by fatigue in the primitive mind is the place of Authority in early religion. There is the fear, which is the soul of tabu, and moves man to let well alone, and the factor of fatigue, the difficulty of changing views. The existing ideas and customs are those

of the group. Many things in modern life are maintained for similar reasons, e.g. the duel, a survival of the ordeal, the attraction of Roman Catholicism for minds fatigued by modern science, and in Protestantism the extreme emphasis on the authority of Scripture, the blind 'idolatry of Holy Writ'. Besides the authority of the tribe and tribal custom there is the authority of the individual, the medicine man, sorcerer, priest, and Pope. (Murphy, 1927.)

#### GENERAL ECOLOGICAL CHARACTERISTICS AND CULTURE

While it is well to recognize that, in any attempt to set forth the most significant features of ecological groups such as the one under consideration, there is a grave danger of oversimplification, yet it is impossible here to follow out in all their many ramifications the results of the change from food-gathering to plant cultivating. Only some of the most important can be noted and that briefly.

(a) Even at the commencement the social organization is more complex as a result of the settled mode of life. The village, as a rule, among primitive cultivators, becomes the sociological unit, being ruled over by a chief. The village community carries out its various duties and occupations as one group, but within the group there are social distinctions. The priest, medicine man, magician, or witch-doctor is often as powerful as the chief or even more so, though the two offices may be combined and held by the same individual. The degree of equality between individuals characteristic of the food-gathering stage no longer exists, though there are again various gradations in complexity among primitive cultivators. When agriculture is combined with the keeping of domestic animals the complexity of social organization becomes still greater. This is the case even when the domestication of animals is kept apart, as the work of men, from plant cultivation, the work of women. When hoe-culture gave way to plough-culture, as we have seen, social organization, became vastly more complex and the higher types of civilization were built up.

(b) The new mode of life gives even the primitive plant cultivators much more leisure. They devote much of their time to ceremonial performances of one kind or another, to

visiting their neighbours, to dancing and music, &c., but they have also developed various arts and crafts. Various manufactures are carried out even among the most primitive of them, e.g. basket-work, pottery, leatherwork, wood-carving, metal-work, weaving, or the manufacture of bark-cloth, in fact the providing of all that they require in the shape of implements and tools, household utensils, clothing and ornaments, weapons, musical instruments, &c. With their more settled conditions of life, their needs in these respects are more elaborate than those of the food-gatherers.

(c) Since they do not roam about, but remain settled in one spot, they build more or less permanent homes. The actual form these take varies in different environments and according to the materials used. The principles of imitation and repetition are also important. All over Africa one form or another of grass hut is found, commonly round or bee-hive-like, or with conical roof. In other parts earth-houses or mud-houses are built, thatched with straw or palm leaves or left roofless. The lake dwellings of Neolithic man, built on piles, are reduplicated to-day in various parts of the world.

(d) Malinowski's work has shown that at least some primitive native cultivators are not content merely to take the line of least resistance and produce the maximum amount of food with the minimum of effort. They work hard and systematically, devote time and attention to purely aesthetic purposes, to keep their gardens neat and tidy, &c., to make a good display, to stand well in the eyes of their neighbours, to produce food or manufactured articles which they can give away.

(e) Unlike the food-gatherers, cultivators are more accustomed to think ahead. The work they perform, at one or more seasons of the year, provides for their maintenance during the intervening seasons. This habit, once learned, has had profound results. It is not only applicable to food but to every other kind of thing used by man and to all types of behaviour. Man has slowly learned to sacrifice the immediate gratification of his desires for the sake of future benefits, to save and store up wealth which can be consumed later. From saving for himself he proceeded also to save for those dependent on him, thus prolonging the period of their dependence. In this particular, as in others, the study of



ecology to some extent coincides with the study of economics. But it is not altogether a question of economics. On the psychological or spiritual side the habit of thinking ahead and planning for the future has had still deeper effects.

(f) As further comparison with the food-gatherers serves to show up distinctly other salient features of the ecology of cultivators, that intimate relationship with wild nature has become weakened, though its influence is still felt. There is a certain loss of that keen alertness of the senses, of the nimbleness of foot and agility, of the extraordinary powers of mimicry, of that open generosity which makes the sharing of all that one possesses more or less a matter of course, of the characteristic geniality, good humour, and kindliness which the food-gathering life engenders, and also of that great power of enduring extremes of want and hardship. There is a loss, moreover, to some degree of that definite knowledge of nature and her ways which is altogether necessary to make existence possible as a hunter and food collector.

Some of the gains, on the other hand, will have been made clear from what has already been said. There is greater security, greater leisure, greater possibilities in the direction of building up a permanent culture and of dealing with permanent possessions of all kinds, and a systematizing of new religious beliefs (in which the Earth Mother assumes the dominant roles) together with an accompanying priestcraft. Magic, too, among cultivators has developed into a highly organized system which, among most of the primitive types, has had profound and even completely dominating results. Magic power cannot be explained intelligibly. It must be accepted as traditionally presented. While it tends to stultify intellectual effort and thus prevent progress, on the other hand, it preserves custom, and prevents the disintegration of established social habits and organization.

(g) Attention, in the present chapter, has mainly been directed towards the more primitive types of plant cultivators. It is among these that the beginnings can be seen of the ecological differentiation of mankind that will be further analysed later. Thus, from the magicians, witch-doctors, or sorcerers of the most simply organized examples, through the priests of the older types of civilization, it is possible to

pass on to the learned and professional classes among modern civilized peoples. Similarly rulers, aristocrats and nobles, or soldiers, or craftsmen and artisans, or peasants, serfs and slaves, or other ecological classes, have their origins very far back, though it was not until after the domestication of animals and their full utilization either in the ancient city-states of the East, or by the numerous tribes of pastoral nomads, which took possession of the great areas of the world's grasslands, that there arose anything approaching the complexity of modern social life. Further details regarding primitive agriculturalists may, perhaps, best be brought out by again adopting the autecological method of approach.

#### AUTECOLOGY

1. *Birth and Infancy.* The new ecological or (taking a somewhat narrower view-point) the new economic position of the plant cultivator has affected his whole life-history from beginning to end. Unless in times of scarcity or famine, through the failure of crops, children are looked upon, not merely with the natural feelings of affection common to all mankind, but also more definitely as an economic asset, being able from a fairly early age to contribute by their work to the general welfare of the community. Among all primitive agriculturalists, women are not only mainly concerned with the growing of plants, but also, to an extent greater than among hunting or pastoral or more civilized communities, they are expected to produce children at very regular intervals of two or three years, during the normal child-bearing period of their lives. The actual birth itself and associated events tend to be treated in a more ceremonial way and not so casually as among the food-gatherers.

It is a common practice that sexual intercourse is not resumed during the period while the woman is nursing the child, which, as among the food-gatherers, is prolonged, often for two or three years. This is one of the reasons, though probably not the most important one, assigned to explain the common practice of polygamy among primitive cultivators. Dr. Richards's work on the autecology of the Bantu tribes of Africa has already been referred to, and the importance she assigns to the process of weaning as a stage

in their life-history. This is also commonly accompanied by ceremonial acts of magic, which form part of the typical *rites de passage*. Whereas the weaning of the civilized baby usually takes place at from three to nine months after birth, and is a gradual process which has little effect on the undeveloped emotions of the child, among savages the child is not weaned until it has developed a much more complex emotional attitude towards the mother, and disciplinary measures are commonly adopted to force the child to abandon the habit of seeking the breast, e.g. painting the nipple with red plant juices or smearing it with pepper or nicotine, &c. Among many primitive agricultural peoples the child at this stage, which marks the end of its infancy, is definitely removed from the mother for a period.

2. *Childhood*. There is considerable variation in detail among different examples of primitive plant cultivators as regards the treatment of children. Usually there is an earlier period of childhood, before their economic tasks begin, when they are allowed complete freedom. But, especially in the case of girls, work is often provided at a very early stage, in looking after still younger children. Boys and girls run about together when they are young, and like all children play games among themselves. Many of these, as remarked in an earlier chapter, bear an interesting significance, in showing relics of earlier food-gathering cultural phases. Later the sexes are often separated, strong tabus being commonly established between brothers and sisters. One of the results of the prevalent matrilineal system is that the relation between father and son is often not so important as between maternal uncle and nephew. Among the Trobrianders, for instance, a man works hard to provide not for his own children but for those of his sister, who inherit his wealth.

While it is perhaps somewhat dangerous to generalize from the relatively few cases which have been studied in detail, yet it appears safe to say that the educational systems that have been evolved among primitive peoples are, on the whole, very effective in what they are meant to accomplish, the training of the young people for taking their proper places as full members of the community. Where women do the work of cultivation, the girls are naturally the first to be set

to work, and often by the age of ten they may be more or less well-trained. Boys commence to hunt with the menfolk if these are still hunters or go through a complete course of training as herd boys, if domestic animals are kept. Sometimes (as is common in Africa) they are deliberately kept on short ration and thus trained to fend for themselves from quite an early age. In other cases where food is plentiful they are more pampered. The influence of the general environment is here apparent and differences of this kind would repay further ecological study. The influence of the organized communal life is generally begun to be felt at a much earlier age among agriculturalists and all higher types than among the food-gatherers described in the last chapter.

3. *Adolescence.* This is always an important transitional period, but among more settled peoples, where the general education begins at an earlier age, its significance is often somewhat more circumscribed. At the same time the ritual connected with it may be very elaborate. Circumcision rites are extremely widespread, and, in other directions, attention is paid to the education of the young in sexual matters, as well as in domestic and other duties necessary for marriage. As among the food-gatherers, ritual dances are an important part of initiation ceremonies. The literature of anthropology is full of descriptive details for this stage in the life-history of the savage, but though the details differ greatly the result is the same. After initiation the young people are admitted as adult members of the community and are eligible for marriage.

4. *Marriage.* In some cases betrothals may take place at a very early age, in other cases only after the adolescent period. Marriage among primitive agriculturalists is mostly exogamous and is regarded largely as an economic contract. The bride may continue to be looked on as a member of her own clan, to which her children will also belong; or if she becomes a member of her husband's clan, then the loss of her services to her own people must be made good in one way or another. With a matrilineal system the former arrangement is the rule, and sometimes the husband joins his wife's village, i.e. the marriage is matrilineal as well as matrilineal. In some extreme cases the husband may not even be allowed to dwell with his wife, but only visit her occasionally.



As a rule polygamy, or more strictly speaking polygyny, is practised, i.e. a man may have more than one wife. Each wife, where there is more than one, has her own house and garden and general belongings. Where polygyny is extensively practised, as in Africa, usually domestic animals are owned as well, though they are not necessarily used in agricultural operations. Extensive polygyny, if the sexes are at all nearly equal in numbers, means that the marriage age for men is often considerably later in life than for women. If both men and women marry at puberty or soon after, and if they live approximately the same number of years, then if some men have many wives, others obviously must do without. This, however, in practice may be largely avoided, if the women marry early while the men wait until they are older, and widows are allowed to re-marry on the death of their husbands. In any case men usually have to wait until they have obtained the necessary amount of wealth in one form or another, while there is no such obligation on the part of the women. Polygyny is not, of course, confined to this or any other particular ecological division of mankind.

The marriage ceremonies among primitive agricultural people are often elaborate, being preceded by prolonged negotiations, which are also bound up with various ritual observances. The offering of food is a common method of proposal of marriage and the sharing of food in a public manner is often the final stage of the marriage ceremony itself. Among the Trobriand Islanders, where complete sexual freedom is allowed before marriage, lovers are careful not to eat together. According to Malinowski: 'We object to an unmarried girl sharing a man's bed—the Trobriander would object just as strongly to her sharing his meal.'

In general the marriage union among this ecological division is as enduring as among others or more so, since marriage and children, as already remarked, are so important in the economic life of the people. Once more, however, barrenness is usually a sufficient reason for divorce, a fact which is easily understandable from the ecological standpoint. In fact, until the first child is born, among many peoples the marriage is not supposed to have been completed.

5. *Adult life.* Space limitations make it impossible to

enter much more fully into the life of the individual plant cultivator. It varies naturally according to his environment—not only the climatic and other physical conditions, or the plants he makes use of, but greatly also according to the place he holds in the society to which he belongs. He may be simply a peasant, living on the produce of his garden, which he either tills himself or his wife tills for him, he may be a magician, or an artisan, or more often, something of all three and a few other things as well, but in any case, he has to fit into a social environment more settled and more complex than those of the food-gatherers; he has to obey more laws and pay attention to more intricate customs, and all the time his life is more dominated by magic and ritual and by his primitive religious beliefs, centred on the mystery of Nature, the seasons, and rainfall and the earth itself on which his life depends. He has often experienced cruelty and has learned on occasion to be cruel himself, unlike his simpler predecessors. He is convinced that sacrifice is often necessary, that life cannot go on without it, and though he may have regrets that Nature demands such sacrifice, he accepts the fact and is duly grateful when sacrifice is made, that rewards should follow.

6. *Death and Burial.* The part that ritual plays in the life of these people has been sufficiently insisted on, and it is natural that the end of life should be marked by intensive ritual observances on the part of the survivors. Here it is necessary to touch once more on their religious beliefs. The death of vegetation is followed later by resurrection, when spring returns; and from early times, in Egypt at least, the vegetation god was regarded as the giver of immortality. Vague belief in the possibility of life after death, however, as we have seen, goes very much farther back, indeed it may have been held even by Neanderthal man. This is a subject on which ecology has a far more extensive record of facts at its disposal, since, in addition to the customs of living primitive peoples, it has, in the burial places of the ancients, an enormous accumulation of data extending over thousands of years, demonstrating, in a most impressive way, the extent to which man's thoughts have always turned towards the problems of death and the after-life. The modes of interment have varied,

and still continue to do so, from simple burial in individual isolated graves to elaborate tombs, which may or may not be designed to receive more than one corpse. Cremation with the scattering of the ashes, or cremation combined with urn-burial, also have an ancient history. The mode of burial and the rites connected therewith not only vary according to the peoples concerned and their cultures, but also according to the social standing of the individual. The death of a chief might involve the sacrifice of many of his relatives, servants, or subjects. In ancient Egypt the cult of the dead centred in the person of the king, and gradually the tombs of their kings became more and more elaborated till elaboration reached its climax in the Fourth Dynasty, when the great pyramids of Gizeh were built. Each was associated with a temple dedicated to the service of the dead Pharaoh who, during his lifetime, was regarded as the son and earthly representative of the Sun god Re.

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## X

# THE ECOLOGY OF THE HERDSMEN AND PASTORAL NOMADS

Introductory—The Domestication of Animals—Types of Herdsmen—Types of Pastoral Nomad—Their Environments—Responses to the Environment and Personal Characteristics—General Ecology and Culture—Autecology—Bibliography.

### INTRODUCTORY. THE DOMESTICATION OF ANIMALS

THE problem of the origin of the domestication of animals remains involved in about as much obscurity as that of the beginnings of plant cultivation. It is fairly clear that the methods adopted must have differed according to the kind of animal concerned. The case of the dog and his early symbiosis with man has already been dealt with. The pig is also known to have been a very early associate of man in Asia and all over Melanesia. The domestication of the pig is combined with the most primitive types of hoe-cultivation, and it is reasonable to suppose that the method of domestication adopted was simply the capturing and taming of the young. It is a widespread and common practice among savages to catch the young of wild animals and tame them. This is often done without any definite purpose in view. We have seen how closely in many ways primitive hunting peoples tend to associate themselves with all the animals of their environment, how the notion of animal guardian spirits arose and clan totems became established, and how the totem animals are regarded as brothers. Of course the totem animals are not necessarily the only ones to be tamed or kept as pets, but the same attitude of mind is to some extent illustrated both by the primitive religious beliefs and by the habit mentioned of taming all sorts of animals. It is an individual habit and the taming process applies only to individual animals. From this to the stage of true domestication, which involves the successful breeding of animals in captivity, is, however, for primitive savages a very big step, and it has been suggested that wild pigs may have been attracted in numbers by the refuse heaps of a village and thus gradually

come to live with man. Similarly the fondness of the reindeer for human urine has doubtless assisted the process of the domestication of that animal by the hyperborean nomads.

Where the animals live in large herds and feed on grass-land herbage, instead of (as in the case of the pig) on roots and subterranean organs of plants, then the process of domestication, of necessity, must have followed different lines. Various hunting tribes of North American Indians used to follow single herds of bison which they hunted and killed from time to time, but otherwise protected to the best of their ability against their enemies, drove to the best pastures, and assisted to increase and multiply. This has been commonly regarded as transitional to domestication though the bison was never domesticated, and it is doubtful how far the process of domestication, which took place in the Near East, actually followed such lines. It is possible that the individual taming method may have been used to assist in the more wholesale process of managing large herds. It has been suggested by Hatt (*Mem. Amer. Anthropol. Ass.* vi. 2, 1919) that tame animals may have been used as decoys. There are ancient Langobardian and Allemanic laws which suggest that, in olden times, the Germans used the ox as a decoy for wild herds of cattle. Among the hyperborean peoples of Europe tamed female reindeer are used to assist in hunting the wild reindeer.

The exact origin of the various domestic animals for the most part remains somewhat uncertain. The majority probably came originally from Asia, but the urus (*Bos primigenius*) a long-horned species of cattle, not only roamed over Europe in Magdalenian times but survived, through the Neolithic period, until the time of the Roman empire. An Asiatic variety, however, *Bos nomadicus*, is supposed to have been the ancestor of the cattle found domesticated in the early settlements of Mesopotamia and Turkestan. Wild sheep of different varieties were found over most of the mountain regions of Asia and appear to have been domesticated first in Turkestan. The range of the wild goat was similar and probably even wider, possibly reaching the Mediterranean region and Europe. The wild ass (*Asinus tæniopus*) is a native of North-east Africa. It is supposed to have been tamed by

dwellers in the Libyan desert and used by pre-dynastic dwellers in the Nile valley. The two-humped camel is apparently a native of central Asia, and was tamed very early. A figure of it has been found in an Egyptian tomb of the First Dynasty. The horse originated in Asia, where Przevalski's horse still runs wild, a type which spread to Europe in Aurignacian times. All these animals appear to have been domesticated before 5000 B.C. (Peake and Fleure, 1927).

The questions of how, where, and when the domestication of the more important domestic animals of the world took place, it is apparent, cannot be answered more definitely than the facts given above warrant, but the region embracing South-west Asia and the adjoining North-east Africa obviously has chief claims to be considered the centre for most of them.

There remains the equally important and even more difficult question of why domestication was brought about. We have seen that savages often tame animals, for no serious purpose, but more or less for the same kind of psychological reason as actuates a schoolboy who keeps tame rabbits or white mice. It is more than a little doubtful whether the first reasons for keeping domestic animals were to use them for food, or to use their hides or skins for clothing, or indeed to make use of them in any way. Yet they did ultimately become of the greatest possible use, and have changed completely man's relationships to Nature, as well as his social organization and general outlook on life. The change of purpose in the association of man with his domestic animals can best be illustrated by a few individual examples. Fowls were originally domesticated by the Burmese for use in divination. This is important as illustrating the close connexion with religious or magical rites. Some African native tribes use them for the same purpose to this day and eat neither their flesh nor their eggs. Yet in the course of ages the egg of the domestic fowl has become one of the most important of all the foodstuffs consumed by civilized man.

The wild sheep has no wool, so it is obvious that the sheep was not originally domesticated for the sake of its wool. Yet to-day the wool of the sheep is the chief source of warm clothing for all the inhabitants of the colder regions of the world. Cattle were probably among the first animals to be

domesticated after the dog and the pig; yet the milking of cattle was only adopted by the ancient civilizations of the Near East at a very much later date. The Chinese, as Lowie (1929) remarks, had wandered away from the outskirts of that civilization before milking was in vogue, and even they, with all their knowledge and patience, did not conceive dairying themselves. Later they were too set in their standards to borrow it from their neighbours. So 'actually millions of people are now raising cattle without tasting a drop of their milk'. On the other hand, many millions more from South-west Asia and all over the continent of Africa milk their cattle, but are particularly unwilling to kill them deliberately, and for no other reason than to eat their flesh, though they eat it if their animals should happen to die. The main exception to this is made when occasion arises for a ceremonial function. Then cattle are slaughtered and a feast is held. Otherwise the natives of Africa generally regard their domestic animals in the same way as a boy looks on his tame rabbits—they are friends and are not there to be eaten.

The slaughtering of cattle for ritual purposes (possibly originally as a substitute for the sacrificing of human beings) suggests another reason for their first being tamed and domesticated. It is a significant fact that the first systematic steps in the process of domestication were taken in the centre where, and at the time when the archaic civilization of South-west Asia was being founded. It is extremely probable that the first domestic animals were regarded as sacred beasts dedicated to the Earth Mother. This view, according to Dawson (1933), is held by Ed. Hahn, the chief German authority on primitive agriculture. This view would not exclude the possibility of domestication having taken place, in other centres and at different times, for other reasons. In comparatively recent times the domestication of the reindeer by the hyperborean nomads is a case in point. It is well to remember, however, that after the first steps have been taken it is comparatively easy to imitate the process with other animals.

With domestication an accomplished fact, the uses to which the domestic animals were put, have, as we have seen, gradually changed, and of all the new uses none has been of



greater importance than the enlisting of their help in man's task of conquering nature and new environments. The harnessing of the ox or the ass, and (very much later) the horse, to the plough, as has been already explained, not only made agriculture a simpler, easier and very much more successful operation, but it has led to agriculture becoming a man's job and thus has completely changed the whole social organization of all the higher types of community.

It is important to note that the process of harnessing preceded the art of riding, which came later and was developed by those who, like the primitive hunters, led a more mobile type of life. Though hunters doubtless became the first pastoral nomads, yet the available evidence strongly supports the assumption that, for the most part, the initial steps in domesticating animals were closely associated with agriculture and were undertaken by more settled peoples—an exception always being made in the case of the dog.

#### TYPES OF HERDSMEN

While it was a comparatively simple task to deal with the relatively homogeneous food-gatherers and even with the more complex organized primitive agriculturalists, the ecological type now under consideration is not so easily dealt with. After man had tamed and domesticated animals he was well on the way to establishing the types of social organization, which we associate with civilized life. There are many examples of peoples who are mainly dependent on their domestic animals—the pastoral nomads, whose mode of life differs greatly from all other ecological types and to these our attention must be specially directed. First of all, however, in brief outline, it is necessary to say something about all the different kinds of keepers of domestic animals.

The simplest is the Melanesian type, where the men continue as hunters and the women as collectors or primitive plant cultivators and the pig is kept. Then we have the type common in Africa where the men keep cattle and make it their business to look after them, while the women grow crops and often take charge of the milk. The cattle, however, in this case, were not originally domesticated by the tribes now possessing them, and in many cases, perhaps in all, were

introduced by tribes of pastoral nomads who first of all conquered the indigenous agricultural peoples and then settled down among them as a ruling class, which, in the course of time, gradually became intermingled with those they had subdued. Agricultural operations were allowed to go on without much change—remaining in the hands of women as from the commencement. The men were not inclined to interfere and were not expected to by their womenfolk. Their domestic animals were kept apart from the cultivation of plants, which was still carried out by means of the hoe and not by ploughing.

Due attention must at this stage be given to the slowly accumulating information, being brought to light by archaeological researches, regarding the actual course of events in Asia and Europe. In spite of many gaps and obscurities in the information available, the work done on the Painted Pottery Cultures has already shown that these lie at the root of all the higher civilizations from China to Europe. They were essentially peaceful cultures and are remarkable for their uniformity, the same domestic animals and the same food plants being used, and even the same type of agricultural implement—the shoe-last celt. The peoples possessing this culture lived in open, unfortified settled villages. Afterwards the archaic civilization of the Near East was built up and reached its climax in the third millennium B.C. It possessed and made use of, not only the plough, but also wheeled vehicles, metals, sailing ships, and the art of writing. There was a written system of laws and industry and commerce became highly organized. The foundations were laid of astronomy and mathematical science. The final stages of this great period (which coincided with the close of the Neolithic period in Europe) saw the commencement of organized warfare, the first to be recorded in history.

Previous to this time warfare was a casual occurrence. Society was not organized for it and there was no fighting class as such. The savage may fight but he is not essentially a fighter. The people responsible for the new type of warfare were the pastoral nomads whose ecology must now be dealt with. The type came into being through the hunter changing his habits of hunting wild animals and devoting his atten-

tion mainly to his domestic herds. How he obtained them must remain a little doubtful, though the probability is that he received them or stole them from the more peacefully inclined settled agriculturalists, but, on the other hand, sections of these may have gradually changed their habits and become more nomadic. We have seen that the menfolk among agriculturalists have liked to continue their hunting or return to it on occasion. In any case the pastoral nomad comes, in many ways, much closer to the primitive hunter than to the agriculturalist. Both hunter and pastoralist are mainly concerned with animal rather than plant life.

#### TYPES OF PASTORAL NOMAD

1. *Hyperborean Nomads* (Chukchis, Koryaks, Tunguses, Lamuts, Ostiaks, Samoyedes, Zirians, and Lapps). These inhabit the tundra regions in the far north between the forest region and the sea. They show interesting stages of progress in the domestication of the reindeer and corresponding stages in their culture from food-gatherers to food-producers.

The cultural advances among the hyperborean peoples are probably of fairly recent date, and may very well have been the results of cultural contacts. Ratzel (1897) says that 'the Tunguses are subdivided into reindeer, dog, horse, steppe, and forest Tunguses, though without drawing the boundaries very sharply; for reindeer Tunguses, who have lost their animals by sickness, have taken to hunting with dogs, or breeding horses, or even fishing on some part of the coast never before visited by them. The Ostiaks, from reindeer-nomads, quickly became a fishing or hunting race'. A lapse back to more primitive hunting methods on the part of people who have only just acquired the art of domesticating wild animals is perfectly understandable.

Recently, as a result of the Jesup expedition, these peoples have been more carefully studied. The Chukchi, of the Chukchi peninsula in North-eastern Siberia, are divided into maritime and reindeer Chukchi. The latter possess very large herds of reindeer, but these are very imperfectly domesticated and it is impossible to milk them, though they are harnessed. Dogs are used only for hunting. The maritime Chukchi depend more on seal hunting or fishing; some

members of the same tribe may be fishermen, others reindeer keepers, and such tribes, with a mixed mode of life, are usually more prosperous than those which depend entirely on seal hunting or fishing.

The Tunguses and Lamuts of eastern Siberia differ from the Chukchis in being able to milk their reindeer, and also to ride them. Their herds are small and are more or less reserved for transport. Dogs are used for hunting. The Tunguses are described as a more refined, cleanly, and elegant race. They live mostly by hunting and fishing and they often hunt very far afield.

The Samoyedes and Lapps, who inhabit the western shores of the Arctic Sea, have adopted a higher type of economic life. They have thoroughly domesticated the reindeer and use them for food (including milk), clothing, and, by harnessing them to sledges, for transport as well. They eat meat, not only when it is fresh, but also salted, air-dried, and smoked. Frozen fish is eaten raw. A favourite drink is melted fat or butter. Dogs are used, not so much for hunting as for guarding the herds of reindeer. The Lapps who inhabit the interior of the Kola peninsula, though still pastoral, have almost ceased to be nomads, for they dwell in villages in huts; but they, too, wander afield in spring and summer to catch fish or, later in the season, to hunt bears or other fur animals. They return to their villages about Christmas time. Even the sites of the villages tend to be changed about every fifteen years. The country does not allow of agriculture, and permanent settlement of any kind is unsuited to a purely pastoral life.

2. *Steppe Nomads of Asia and Europe* (Mongols, Tanguts of Tibet, Buriats, Kalmucks, Tartars, Kirghises, and Turcomans). These inhabit the broad belt of temperate grasslands and deserts which crosses Asia and Europe and are bounded by the much more densely populated agricultural peoples of China, India, and South and West Europe. It is in this huge area that the domestication of the ox, sheep, goat, ass, horse, camel, and yak has been brought about. Sheep (which are by far the most numerous), goats, or cattle are the most important sources of food, skins, &c., but nevertheless, though used mainly for transport, the horse is the most important



domestic animal since mobility is the first essential in their mode of life. They make use of mare's milk, from which by fermenting they make the spirit *koumiss*.

In drier parts the camel replaces the horse as a transport animal. The flesh of their animals is less eaten by these nomads than might be supposed, partly, no doubt, because of their desire to keep their wealth intact. They eat the animals that die or that they can steal, or the wild animals they kill by hunting. At the beginning of winter occasionally they slaughter part of their domestic herds for winter provision, but otherwise they live largely on milk products, curds, cheese, butter, and *koumiss*. A certain amount of agriculture is pursued even in the steppe regions, millet being the chief crop grown, but they obtain other cereal foods by trading, rice from the south and east, and wheat from the north and west. 'Brick Tea', which is sometimes used as a currency, is also got by trading. It has become practically a necessity. It is often boiled with salt and butter and is more a soup than a 'tea' as we regard it. Tobacco is also an article of trade. Fruits and roots form another part of the vegetable diet and are gathered by their women and children. Some of the Kirghis, Turcoman, and other peoples eat fish as well. The fish are caught in the rivers and lakes or around the coasts of the Sea of Aral and the Caspian. The coast Turcomans preserve fish for the winter by salting, drying, or boiling in fish oil and covering with a bladder.

3. *The Nomads of North Africa, Arabia, and South West Asia.* Among the Arabs three classes are distinguished: (a) the Arabs of the towns, who are merchants, traders or workmen, and form the settled, peaceable class, (b) semi-nomads, who dwell in tents or mud huts on the edge of the desert, and (c) the Arab-Bedu or the Bedouins, who are the true nomads, and have been for thousands of years. Of all the Arabs, the Bedouins have tended to maintain to the greatest extent their racial purity. They have blended to some extent with the Berbers of North Africa and, to the south, many of the Nubians are of Arab origin. The ethnology of all this region is distinctly tangled and complex, but at present we are mainly concerned with the mode of life of these peoples as the basis of their ecological relationships.

The Bedouins and other nomads do pursue agriculture to some extent; on the oases of northern Arabia they grow barley, wheat and, in more recent times, maize, and they cultivate the date palm extensively. But, commencing no doubt as peaceable herdsmen, for thousands of years, they have developed and perfected the marauding side of life. 'Robber' they regard as a title of honour. Probably change of climate and the increasing aridity of North Africa has intensified this trait, though it began very early. Pliny has said that the Arabs were, in his time, equally addicted to theft and trade. They still hold up caravans for ransom or grant them safe conduct at a price. And this applies equally well to all the tribes of Sahara nomads, whether Arab, Berber, Nubian, or Negroid. The camel, in all the drier areas (as in Asia) has tended to replace the horse which, however, in all areas that are suitable, continues to be used. Formerly the export of horses from Arabia was an important trade. On the high plateaux of Algeria and the northern part of the Sahara cattle, and particularly sheep, are kept by the nomads, who migrate from the plains to the mountains and back again, according to the seasons. The milk of the camel, with a little meal added and possibly a few dates, supplies the frugal diet of the Bedouin. Among the Nubians, milk and durra with butter, dates, honey, and, in times of scarcity, locusts, are the chief food.

The Tuareg (sing. Targui), or 'People of the Veil', inhabit the desert region of the Sahara, north of Timbuktu. They are camel nomads. The tribes are divided into two classes, the nobles and vassals and each class owns slaves, which really form a third, non-tribal class. This is again divided into household slaves and outdoor slaves. A man's status is determined by the class of his mother. Though the government of the tribe is patriarchal, like most other nomadic peoples, descent is matrilineal. The Tuareg are also exceptional in their treatment of their women, who are allowed complete freedom, own property, take part in public affairs on a footing of equality with the men, choose their own husbands and do not veil their faces. The men, on the other hand, live and sleep in their veils.

4. *Other African Nomads or Herdsmen.* The rest of the

continent of Africa shows a more complicated relationship between nomadism and agriculture. The Hamitic nomads have largely overrun and conquered the Negro agriculturalists and settled down among them. There have been all degrees of admixture of blood. In the case of the Bahima of Ankole, we find a tall cattle-owning aristocracy ruling over the Bakera, a short pure Negro agricultural class, though there has been some admixture. The same thing is seen among the Baganda, but here the admixture is greater. The Zulus are still more uniform. These are a few examples, but in the continent as a whole there is almost infinite variety in the ecological relationship of the pastoral and agricultural elements composing the different communities. Generally speaking the rulers are drawn from the cattle-owning section, while the peasant agriculturalists do not possess cattle, or only a few, but keep goats, sheep, and dogs. The agriculturalists supply the community, as a whole, with cereal foods. Some peoples, e.g. the Masai, hardly eat any cereals whatsoever, but live entirely on their herds. Among others, particularly the various South African natives, the combination of herding and agriculture has been welded firmly together and, as already described in our last chapter, the animals are looked after by the men while agriculture continues to be carried out by the women.

5. *The Hottentots of South Africa.* These, though pastoralists, are allied both racially and culturally to the Bushmen. They are supposed to have migrated southward from North-west Tanganyika, but when the Dutch first settled in South Africa, they found it occupied by Hottentots all over the western and south-western portions and as far eastward as the Kei River. Their original cattle were apparently the large-horned type still found in East Africa (*Bos aegypticus*) and their sheep were of the fat-tailed, hairy type, but neither of those types is now found amongst them in a pure-bred condition. Their goats they have recently acquired from their Bantu neighbours. Though land used to be considered to belong to the tribe as a whole, each family had its own live stock. The families living together, however, usually pastured their animals in common. Each tribe was always prepared to defend its own territory against invaders, but no

individual, not even the chief, was allowed to own land separately. Wild game, on the other hand, was considered to be the property of the chief. Milk mixed with plant juices and allowed to thicken and become sour is the staple food of the Hottentots. In contrast with the pastoral Bantu tribes milking is the work of the women. At times when milk is not plentiful the men engage in hunting and trapping, and, at all times, the women supplement the milk diet by food collecting, but they do not cultivate cereals or other plants. The Hottentots, therefore, are an example of the adoption of a pastoral life by food-gatherers, while retaining many of their former habits, and the comparison of them with their purely food-gathering connexions, the Bushmen, is full of ecological interest.

#### THEIR ENVIRONMENTS

The general environments of pastoralists must all be of such a nature as to provide a natural food supply for their domestic animals, and the most widespread of these are the vast regions covered by the world's grasslands and shrub steppes. These are the regions of summer rains and dry winters, which are also most suited climatically, and apart from the food supply, for most of the animals that have been domesticated. Regions of cold wet winters are not so suitable. The animals in such regions require more shelter and warmth than can be easily obtainable unless artificially supplied. Even wild animals are accustomed to migrate more or less extensively with the change of seasons, partly in search of food, partly to find the most suitable climatic conditions, and the pastoral nomad with his domestic herds has always proved ready to follow Nature as a teacher. In drier parts succulent shrubs may be an even richer source of nourishment than grasses, but in such regions, as well as during dry seasons elsewhere, water often becomes a limiting factor.

Pastoral nomads have thus been able to make use of huge areas of the earth's surface that have not, until very recent times, been touched by agriculturalists, and the pastoralist, with his controlled herds, has made a much fuller use of them than the purely food-gathering types, which he evolved from and supplanted.



Though the pastoral nomad retains many of the personal characteristics of the hunter, and is accustomed to hunt wild animals, whenever an opportunity occurs, the most important part of his living environment is represented by his own domestic animals which he has to look after. His habits, therefore, vary somewhat according to the type of animals he possesses, but the more essential features are the same and the differences not very important. Many nomads possess several different kinds of animals and, especially in Asia, use them for different purposes, cattle, sheep, and goats for food and clothing, and the horse or the camel for transport.

The social organization of the pastoral nomad, as is to be expected, is much nearer to that of the food-gatherer than to that of the agriculturalist. The family, clan, or at most the tribe is the common unit. Only occasionally have these been combined under powerful military autocracies, which have never been very enduring, unless they settled down to adopt the mode of life of the agricultural peoples which they conquered. The influence of Mohammedanism, however, has resulted in the uniting of one large section of nomads—the Arabs and others who have adopted that religion—and has created a certain national spirit.

The pastoral clan or tribe is usually patriarchal and aristocratic, men keeping the power in their own hands. The office of tribal chief, in most cases, is hereditary. Women are, for the most part, placed in a position of subjection, though the Tuareg form a notable exception to this rule. Polygyny is practised, but mainly by the richer nomads, a wealthy man's position being determined, not only by the numbers of his animals and tents, but also of his wives. Among desert tribes monogamy is the rule. Wherever more settled conditions prevail, as in the case of the desert, the women are secluded. The Asiatic Kirghises have a proverb 'Women's advice is only good for women'. She is regarded as an inferior being. Yet, when the nomad is on the move the degree of seclusion for women has to be relaxed. The work of the camp falls to their lot, milking, cooking the food, packing and unpacking the tents and their contents, in fact, all the ordinary routine work; and most of it is done out of doors and under conditions which makes the wearing of the veil

impossible. When the men go off hunting or foraging or fighting the full responsibility for tents, animals, and children falls on the women who remain behind. There are, of course, considerable differences shown according to the stages of evolutionary progress. Some like the hyperborean nomads or the Hottentots have only progressed slightly beyond the food-gathering stage. Others, such as the Asiatic nomads or the Arabs, have reached from time to time a high degree of efficiency in their adaptation to the new environment and new mode of life.

#### RESPONSES TO THE ENVIRONMENT AND PERSONAL CHARACTERISTICS

The transition from the hunting to the pastoral life has involved much less important changes in the mode of life than in the case of the change from food-gatherer to agriculturalist. The responses to their environment therefore on the part of pastoral nomads continue to a large extent unaltered. The nomadic life is a simple one and its keynote is mobility. Everything is made subservient to this, a fact which will be made more obvious when the culture of the nomads is described. It is a life which demands to a large extent the same intimate knowledge of Nature and wild life possessed by hunters, and it also is one that calls for rapid decisions and vigorous action at times. At the same time, since their domestic animals supply them with their food, clothing, and means of transport, the pastoral nomads are relieved of the necessity of *continually* being active in the pursuit of wild game or in search of other sources of food, so that the keenness, alertness, and constant activity of the food-gatherer is not always evident in the pastoralist. The menfolk, especially, tend to develop easy-going and indolent habits, except in matters connected with hunting or warfare. They are content to leave all the everyday duties to their women, all the work connected with their tents, even the making of them and the striking or pitching of them when on the move, the providing of fuel and any plant collecting or plant cultivation that is undertaken. The men look after the herds (unless the animals fall sick, when the women again

take a hand). The men, therefore, have abundant leisure—a thing unknown to the simple food-gatherer.

This leisure they have used not always in an idle fashion, though they have often become thoroughly lazy. But they also use it in hunting, and in fighting, and in undertaking various arts and crafts, such as carving, metal work, and weaving. They have developed transport and trading on the one hand and organized warfare, robbing and thieving on the other. Their domestic animals not only represent the source of supply for their everyday needs, but also their accumulated wealth. The distinction is not unimportant. The typical nomad has a high regard for his beasts. Even when he possesses far more than are necessary to supply all possible demands, he prefers to live frugally or find other sources of food, by hunting or collecting or cultivation, rather than kill and eat them. He uses their products, of course, their milk and their wool, but his whole rank and standing in the eyes of his fellow men depends on the number of his animals and he refrains from killing them as long as possible. Some African tribes even go the length of drinking the blood of living animals without allowing them to die.

The tendency to allow herds to multiply as much as possible brings about another important result, depending on the conflict with the climatic environment. Cyclic climatic variations have probably always and everywhere taken place. During a succession of good years, when food is relatively abundant, the numbers of domestic animals naturally increase very rapidly. There follows a lean period, when rains fail, plant food diminishes, and the increased herds cannot be supported within the limits of their customary feeding areas. This is what leads to more extensive migrations, to conflicts with the nomadic occupants of other areas, to raids on areas occupied by more settled agriculturalists, to robbery and warfare.

The mode of life with its continual changes of environment and its subordination of everything else to the necessity for extreme mobility has engendered habits of orderliness and discipline as well as physical fitness. All this in turn leads to effectiveness in warfare, and it is not surprising that the pastoral nomads should have found it easy to subdue

the peaceful settled agriculturalists even when these had progressed very far in building up a higher civilization. Fighting among themselves, to obtain possession of one another's pasture grounds or herds, has not been so one-sided a matter, but it has served to improve their fighting methods, and whenever an able leader has arisen among them, able to bind together the different tribes, even if only for a time, they have become quite irresistible.

The habits of orderliness and discipline referred to are well illustrated among the Asiatic nomads, e.g. the Kirghises, by the exact and old-established order in which camp is pitched and struck. Though in a Kirghis tent or yurt there is room for forty people by day and twenty by night, every position for man, woman, or child, for all weapons and utensils, is exactly determined and never altered. This is why it is possible for all the contents to be packed and loaded in an hour's time. Ratzel, however, remarks that, though the order of the yurt is great, its cleanliness is small. Nomads, as a rule, are not cleanly, especially in wild regions where water is scarce and where, in all seriousness, the proverb says that God is not gracious to men who have no vermin about them. On the other hand, wealthy Kirghis or Mongol princes have often built for themselves, in addition to their tents, quite palatial houses, where they can temporarily come to live. Kubla Khan's 'stately pleasure dome', at Xandu or Xanadu, has often been reduplicated on a lesser scale, and the present habits of those nomads have probably not altered very much, since the days when they were visited by Marco Polo.

Of the personal characteristics of the nomads one of the most notable is their regard for hospitality, which is everywhere looked upon as a sacred duty. The stranger may be attacked, robbed, or slain but, if he has once been accepted as a guest, he must be lavishly entertained and everything possible done to secure his comfort and meet his wishes. Other characteristics of the nomad include a love of freedom and a spirit of independence and self-reliance, with courage, hardiness, quickness in reaction to the stimuli of his surroundings, a good sense of locality and direction and keen senses generally. He is fond of poetry and of music. His compara-



tive isolation has tended to preserve the purity of his blood and he has an intense pride in his race, and himself, and all he represents. Isolation always tends to foster this kind of spirit. It is based on deeply important biological laws, and its revived manifestation is seen in the aggressive 'nationalism' which is characteristic of so many modern peoples, who strive after as much isolation as they can secure, even to the detriment of their economic interests.

#### GENERAL ECOLOGY AND CULTURE

Among the relatively primitive pastoralists a very interesting ecological relationship with water is described for the South African Hottentots by Mrs. Hoernlé (1923), which is deserving of special and somewhat more detailed reference in this place. According to her description, 'They distinguish all the various ways in which water may be conserved and name every spot in their territory where these different kinds of water may be found, so that the greater proportion of places to which the natives have given names are precisely those at which there is water'. Such places include rivers, hot and cold springs, water holes dug in moist sand, deeper wells, natural reservoirs in basins of hollowed out rock, ponds vleis, &c. The most important social ceremony of the year is the annual rain-ceremony in which the whole tribe used to take part.

The Nama believe that water has great protective powers against any anti-social forces, but at the same time is extremely dangerous to the members of society, whenever they are withdrawn, in any way, from the powerful protection which society gives them. Mrs. Hoernlé lays stress on this ambivalent character of water. It is, on the one hand, protective to the tribe and its members, on the other hand, a danger to members of the tribe who are, for one reason or another, in a critical condition. As examples of the rites and ceremonies, connected with the protective power of water, by means of which its social value is shown, Mrs. Hoernlé describes the custom of throwing cold water on the grave of a person newly buried, as a protection against the ghosts, which hover over graves or come from them to cause disease, or to fetch other persons, especially relatives, to die. Another custom is to throw water

in the path of a whirlwind, which is looked upon as a devil, an evil thing which brings sickness and death. When one is visiting an old locality of a tribe, and one is exposed to dangers from the ghosts of ancestors, it is customary to take wet clay from the water-hole and put it on the body, at the same time begging the goodwill of the spirits and claiming relationship with them. 'One identifies oneself with the place and its spirits and so gets protection and support instead of hostility.' When a Nama goes visiting relatives in another tribe, the head of the kraal visited takes wet clay and soot from a pot and marks the visitor's forehead—a sign that one is being admitted to the full life of the society and so to its protection.

These and other instances show how water or wet clay may protect members of the society from things or persons which might harm them. Mrs. Hoernlé quotes other examples from the literature dealing with the Hottentots, e.g. the making of an offering to 'Tusib' 'the old man of the water' before drinking it, and the necessity for a wife to pour water about while her husband goes hunting, so as to ensure his success.

As regards the examples of the dangers from water it is important to understand the many 'transition rites' of Hottentot life. While things are normal each person belongs to a definite group in society, but at certain times a person is removed from his group, e.g. when a child reaches the age of puberty, or when a married person becomes a widower or widow, or, later on, when such a person re-marries, or even within a group a woman after childbirth, or a girl during her menstruating period, or when a person contracts a disease, all these are in a state of instability and exposed to danger. Water is one of the things from which such a person must be carefully protected, another is raw meat. Seclusion of one kind or another is necessary in all such cases, until initiation into a new group is secured and normal life resumed. Mrs. Hoernlé concludes by saying that the Nama ceremonies, connected with water, are all intelligible and form an harmonious whole, if we realize that water is, of all the essentials of a social life, the most difficult for this primitive people to provide, that it is, therefore, one of their most important social posses-

sions, and is invested with great power, essentially protective and wholesome so long as social life runs its normal course, but exceedingly dangerous to all forces which strengthen society, or to the members of the society themselves when the social bonds are loosened.

In their religious beliefs and magic the Hottentots come much nearer to the Bushmen than to the Bantu agriculturalists. The witch-doctor or magician, though not very powerful among them, could use his powers either for good or evil. He is usually also a herbalist. The Hottentots pray to the moon and hold dances and musical parties at the time of the new or full moon. They believe in the ghosts of dead people and worship mythical heroes, who are partly personified forces of nature, e.g. those producing rain.

Like the Hottentots, the hyperborean nomads have not progressed much beyond the food-gathering stage and it is interesting to find that their indigenous religion has also remained relatively primitive. It is that known as Shamanism, a religion which has not quite reached the sacerdotal stage. The Shamans are partly medicine men, partly soothsayers or prophets, partly exorcists or priests. They do not constitute a special caste or priesthood. They may be either men or women, married or single. There are white shamans and black shamans, who deal with good or bad spirits respectively. Mikhailovski (1895) says that Shamanism, at the present time, is in a moribund condition. Buddhism, on the one hand, Mohammedanism on the other, not to mention Christianity, are rapidly destroying the old ideas of the tribes.

As in the case of the agriculturalists, however, it is to the Near East and its ancient civilization that we must turn to see the rise of the true type of pastoral religion. While the primitive agriculturalist regarded the Earth mother as his great goddess, the pastoralist, like the hunter before him, turned his attention rather to the sky and all that he saw there the sun, moon, and stars, and all heavenly phenomena. The Sky god, to begin with—and still among primitive nomads—is regarded as a vague impersonal power, yet is also looked on as the heavenly father, the creator of everything, and the supreme ruler. He goes under a variety of names. Later, as the pastoral peoples developed into warriors, they multiplied

the number of gods, but one remained supreme, the king of the gods (Zeus, Jupiter, Odin, &c.). The sky god is also the god of the thunder and of storms (Adad and Amor, Teshub, Indra or Thor). From this type of religious outlook the higher religions ultimately developed. The pastoral mode of life has encouraged introspection, contemplative thinking, and strong religious feelings, which have sometimes produced intolerance and fanaticism. Abraham and the Israelites were nomads, and the Jewish religion, in itself and through its connexion with Christianity, has had an enormous influence on the modern world. Yet the nomadic Semites, before the Hebrews settled in Canaan, had no organized priesthood. After the Jews became a settled people, and as their worship became more complex, a sacrificial priesthood developed, ultimately forming a distinct class, the Levites. They had common traditions of law and ritual, which they traced back to Moses, but, though they declared the law and interpreted divine judgements, they did not administer the law or enforce it. That was the function of the king and his executive. The influence of the Hebrew priesthood on Christianity and Christendom was the influence not so much of a living institution as of the Old Testament itself and particularly the priestly code of the Pentateuch. Mohammedanism also grew out of Judaism, but orthodox Islam has never had true priests, who perform religious rites for the sakes of others, though it has teachers (*ulema*) and ministers (*imam*), more or less after the fashion of Protestant churches. All the higher religions, however, distinguish degrees of holiness and 'holy men' are not always easy to distinguish from true priests.

While the keynote of the mode of life of pastoral nomads is mobility, that of their material culture is simplicity. The second follows from the first. It is impossible for them, without sacrificing their mobility, to burden themselves with many or bulky possessions. Such as are transported are connected with the necessary provisions for feeding themselves, for shelter, for clothing themselves, or for defence and attack (their weapons). There is some degree of variation in all of these among the different nomadic peoples and environments.



The Hottentots live in transportable huts which, when camp is pitched, are arranged in a great circle, with the herds kraaled in the centre. The huts are made of a framework of light pieces of wood, tied round with withes and covered with rush mats. When completed they are of beehive shape. They are cool and well ventilated in hot weather, when the rushes contract, and perfectly dry in wet weather, when the rushes expand with the moisture and grip closely together. In winter they are lined with skins. The floor is smeared with a mixture of cow-dung and blood and covered with skins. A depression in the centre is the hearth for the fire around which the inmates sleep. When the camp is shifted the huts are dismantled, and transported on the backs of oxen, specially trained for the purpose.

As regards other nomads, space limitations prevent all but the briefest descriptions of their dwellings. The Mongol 'yurts' are constructed of a lattice frame supported by poles and covered by felt, leaving a space at the top for smoke to escape. The whole structure is tied down by ropes attached to large stones. It can be very quickly taken to pieces and packed up for transport. A smaller, lighter, low, ridge-pole type of tent is used for more rapid travelling, but not in the villages. The villages are only semi-permanent. They are usually placed near a water supply.

The Chukchis live in large round skin tents, supported by a framework, which is held up by three poles tied together like a tripod at the top. The whole is weighted down with stones. Inside there is a smaller tent supported by horizontal poles attached to the outer framework. This represents the more permanent type of dwelling, but the reindeer herds-men carry a lighter tent. When the whole family migrates to the forest at the onset of winter, the larger type of dwelling is erected. Transportation is by means of sledges.

The Arab nomads live in tents or a tent-like hut made of reeds or grass, which can be struck and loaded on camels, or huts built of the leaves of the doum-palm. The town dwellers have built houses of stone or bricks but (though they themselves may not be nomadic) the influence of the prevailing mode of life is shown by the fact that the houses, if isolated, wherever possible, are built on steep rocks or on hill slopes

which can be easily defended or, where not isolated, the homes are often packed closely together. Defence and protection against robbers is the first consideration. In the northern Sahara the Algerian and other nomads have houses in villages, which they look upon rather as storehouses than as dwellings, since for four-fifths of the year they live in tents following their flocks. Only part of their provisions, however, may be stored in their own houses. The bulk of their wheat, barley, wool, dates, butter, dried meat, and other food or other wealth is usually stored in a common fortress or *guelaa* for the sake of better protection.

For clothes the more primitive nomads, such as the Hottentots and Hyperboreans, use skins. The Mongols use felt, made from the wool of sheep and camel's hair, to wear next to their skin, and in winter they use skin overcoats. They also wear leather breeches. In later times, by trading, woven cloth has been obtained, and the fashions have somewhat changed. The 'Khalat' is a long, wide coat, tied at the waist, like a sort of dressing-gown. It is made of linen in summer, of fur or felt in winter. Sheep-skin caps are widely worn; felt stockings are used as part of the winter clothing. Long leather boots are worn and seldom taken off. Among the Turkish nomads, the richer classes use striped silks worked with gold for outer garments, some of them being very costly.

The Bedouins wear a long white shirt with a leather girdle, together with a brown, black or white striped cloak, and a white or coloured turban. In winter a sheep-skin coat may be worn. Among the Nubians, in the warm south, clothing may be reduced to a single cotton loin-cloth.

Most nomads take far more interest in their weapons than in their clothes. The more primitive types have retained their primitive weapons until quite recent times. The Asiatic nomads retained their bows and arrows long after they possessed firearms, possibly because of the noiselessness of the former. The spear is also an important weapon for the nomad, and the Tibetan nomads use slings. The Hottentots used poisoned arrows like the Bushmen. It is among the Arabs, however, that the highest degree of pride is taken in their weapons. Swords, spears, daggers, are regarded not only as weapons but as ornaments and insignia of rank. They

are often beautifully made, with silver mounting and highly ornamented. The bow, once in general use, has now been supplanted by firearms.

In regard to his everyday life, the nomad, as we have seen, is of frugal habits. He demands little in the way of luxury. Feasting and display are reserved for ceremonial occasion. Clothes used for everyday wear are simple, but the abundant leisure has led to a certain elaboration in ornamentation and personal adornment for special occasions. He shows great respect for ancient customs, and his type of culture has hardly changed for thousands of years. Though they have plenty of time on their hands their arts and crafts have not progressed very far. They sometimes carve articles from wood where wood is available. Among the Asiatic nomads the women weave linen on a very simple type of loom and embroider garments with silks. The making of oriental rugs and carpets is said to have originated among nomads, but it has now become localized in towns and villages in Persia, Turkestan, and other bordering countries, where former nomads have settled down permanently. Felt is manufactured from wool and camel's hair by damping, rolling with the hands and finally treading out. The largest export trade is in leather, but it is incompletely prepared, through lack of tanning materials.

While the simple pastoral nomad has developed into a robber, fighter, and warrior on the one hand, he has, on the other hand, developed into a trader. The simplest trade is where he buys, from more settled peoples, luxuries which he cannot produce, e.g. flour, tea, coffee, tobacco, and pays for them by selling the products of his animals, butter, leather, &c., or by selling some of the animals themselves, or sometimes by obtaining and selling products of inaccessible or desert regions, e.g. salt. From this type of bartering a more elaborate system of trade has developed, and to facilitate exchange money systems have been invented. The nomad becomes a middle-man or merchant, transporting goods of various kinds from one region to another, by means of his caravans of camels. The name 'ship of the desert' has long been applied to that very useful animal. A highly organized trade in ivory or other goods between Egypt, North Africa,

and the Negro countries to the south dates back to very early times, and the nomadic trader or merchant has been responsible for the growth of bazaars or market towns throughout the region traversed by his great trade routes, e.g. Timbuktu, Damascus, Samarkand, Bagdad.

The nomad, however, on many occasions has combined his activities as a raider with his functions as a trader. The goods he has sold have not always been paid for by him. Especially is this true of his trade in slaves, who have generally been treated more or less like any other article of merchandise. Organized slavery is one of the important results of the nomadic development of warfare and marauding, and this has had far-reaching effects on the social organization of nomadic peoples, and on their relationship to the agricultural or weaker pastoral peoples raided by them. Arab forts or Zeribas, with permanent garrisons, were founded in the south to serve as bases for slave raids into the interior. Thus they penetrated into the very heart of the continent of Africa. His mode of life makes it difficult for the nomad to keep slaves for himself, unless he possesses, as the richer nomads do, a permanent house in addition to his tent. The slave trade, though by no means finished, is gradually becoming a thing of the past and even the camel will probably soon cease to compete with the motor lorry.

#### AUTECOLOGY

The life-history of the pastoral nomad, in many ways, comes much closer to that of the food-gatherer than to that of the settled agriculturalist. The similarity to the former is to be correlated with their similar modes of life and particularly to their mobility and relationship to the animal world. Differences are due to the altered conditions, brought about by their domestication of animals, and to their different social organization, with the dominance of men and subjection of women, or in a word to the new environment they have created.

1. *Birth and Infancy.* Pregnant women, among the nomads except in the case of the richer ones, do not as a rule interrupt their normal occupations, but among the different types there are various tabus (e.g. being present at the slaughter of an



animal) and observances. Towards the end of her pregnancy the woman may go back to her mother or her mother may be summoned to visit her. Among the Mongols birth takes place in the presence of the elder women of the tribe. Among the Kirghises, while parturition is going on, a lamb or sheep is killed and part of its flesh thrown into the fire to propitiate the spirits. Broth is prepared from the rest of it as food for the mother, and the baby is washed in the scum. For two or three days after birth the baby is left largely to itself. Among the Kirghises the mother will not hush its cries, and among the Hottentots, will not allow it the breast. As a result the child is often too weak to suck when allowed to do so. After the birth there is usually a seclusion period which may be terminated (e.g. among the Hottentots) by ceremonies (transition rites) including a feast given by the father. Another custom of the Hottentots is worth mentioning. After the baby can be removed from the hut where it was born, it is taken out into the first rainstorm that occurs, so that it will know the rain and not be frightened by it and the rain will not harm it. The mother is similarly reintroduced to water.

Among the Mongols the baby is baptized and named, as soon as possible, by dipping three times in a bucket full of salt water.

As among all primitive peoples, the period of nursing by the mother is prolonged. The effects of this have already been fully discussed. The patriarchal system of the nomads has resulted in boys being more welcomed at birth and ranked more highly from birth onwards. The birth of a girl is commonly regarded as a misfortune, and in former times infanticide was common, especially in the case of girls. Regulation of the size of families is more important for nomads than for settled agriculturalists and abortion is more prevalent among the former.

2. *Childhood*. A common practice, especially among the wealthier families, is for each boy to be allotted a special cow which he makes use of, and, as soon as he is able, milks for himself. Otherwise the first social tasks for boys are looking after the goats, if these are kept, and later on herding the cattle. The girls help their mothers in their many duties.

The children are encouraged at an early stage to learn to fend for themselves and they are initiated into the methods of the food-gatherers, to catch small animals, dig roots and bulbs, seek wild honey, &c. As usual all children play games. Among the Hottentots the children, both boys and girls who grow up together in the same place, are regarded as 'mates' for the rest of their lives. They elect a 'captain' who chooses a 'lieutenant' for himself and both have younger boys as personal servants. They direct all games and youthful activities of all kinds. The adults leave the management of their own affairs largely in the hands of the children, thus inculcating habits of self-reliance, combined with interdependence and mutual obligation that have far-reaching psychological and social results. At the same time, in other directions, the bonds between parents and children are maintained and strengthened. Parents are treated with affection and respect, as are all older persons.

3. *Age Grades*. This institution, which is common in all parts of Africa where Hamitic influence has made itself felt, shows a further elaboration of what has been described for the Hottentots. At regular intervals, varying from two to eight years according to the tribe concerned, all the candidates who have together first been admitted as members of an age-group, are promoted together to be members of the next stage. This is continued until old age is reached. The adolescent stage in this case is only one of several, though an important one.

The initiation to the lowest degree takes place on an average about the age of eight, and others follow at intervals, e.g. about the ages of thirteen, eighteen, twenty-eight, and at intervals later. (Driberg, 1932, for the Didinga.) Attention, during the first initiative period, is largely directed to methods of fighting, training in the use of weapons, and in methods of defence, how to herd cattle and look after them in every way, finding good pasturage for them, &c., how to make the best economic use of the full resources of their environment, particularly useful plants, and on the social side, how to behave towards the rest of the community, particularly their elders. Discipline is very rigorously enforced and hardships deliberately inflicted. Instruction is given in ritual obser-

vances and religious beliefs. They are taught songs and dances. At subsequent initiation stages the instruction on the same subjects is carried farther. Sexual instruction forms an important part of the adolescent stage. Later on more attention is devoted to social conduct and law. Until about the age of twenty-eight military training, among warlike tribes, is of first importance and the warriors are not allowed to marry until then. There is reason to believe, though less is definitely known about them, that women, in their secret initiations, receive parallel courses of instruction. In all cases more advanced age-groups help in the instruction of those junior to themselves. Driberg (1932) lays emphasis on the fact that the institution of age-grades has an integrating force which cannot be over-estimated. It serves to maintain the unity of the tribe as a whole, since it cuts across clan loyalties or family interests. Less is known regarding the educational system of the Asiatic nomads. To some extent any system making for efficient adaptation to the needs of the community must of necessity follow similar lines to those described above. In general, where tribal organization is looser, where the separate clans lead a more or less independent existence, then the educational system is simpler.

4. *Marriage*. Betrothals usually take place before the marriage age, sometimes even from infancy, and marriages are exogamic. A 'bride-price' is paid either by the father or family of the bridegroom or by himself and, if he is too poor to provide what is demanded, he may be allowed, like Jacob, to work for the bride's father for a period of years by way of compensation. The 'bride-price' that is paid does not mean merely that the bride is purchased. It is meant partly as economic compensation, but it also has other implications on the religious, legal, and social sides. The marriage ceremonies naturally differ considerably, but there are certain indications that formerly 'marriage by capture' was a method adopted, both by the Asiatic and African nomads. Among the Nama Hottentots the husband lives with his wife, at the home of her parents, for at least a year or until the first child is born. Sometimes the matrilocal residence becomes permanent, but usually it only lasts for a time and the final residence is patrilocal.

Polygyny among nomads is practised mainly by the wealthier classes. As we have seen, a man's status depends, not on his material possessions, but on the size of his herds and the number of his wives. Among the Mohammedans, however, the number of wives allowed has been restricted to four. Divorce is common and is allowed on various grounds. Where women are kept in a condition of subjection adultery, on the part of the men, is not considered a wrong, but among simpler types such as the Hottentots, ill treatment of the wife is a ground for divorce if it is proved to the satisfaction of the tribal council. Driberg has pointed out that, where prenuptial chastity is not expected either of young men or women, marriage is more stable and often divorce is not recognized, but when virginity is expected in a bride there is a corresponding laxness after marriage and divorces are of frequent occurrence. Among nomads, the levirate is commonly practised, i.e. the right of a brother to inherit his brother's widow. It means that marriage is between two groups and is not terminated by death. Levirate is not merely a right, it is also regarded as a duty to 'raise up seed' for the deceased so that such children may be his heirs. The corresponding sororate is the right of a husband to marry his wife's sister either when the first wife is alive (especially if she prove barren) or more commonly after her death.

5. *Death and Burial.* Perhaps it is in their treatment of the dead that the nomads differ most from the agriculturalists dealt with in the last chapter, though, once more, it is difficult to generalize. Practically all types of mankind believe in some kind of life after death, even if it is a vague belief in the persistence of the souls of their ancestors and the possibility of those entering once more into the bodies of their children. The ceremonies connected with death are therefore made up of 'transition rites' like any others. Ghosts of the dead are supposed to hover round their graves, and it is always necessary to propitiate the ghosts of one's ancestors. Prayers may be offered at the graves of the dead. Among the old Cape Hottentots there were no special burial grounds but the body was buried in a special niche at the side of a deep hole, the head being bent between the legs and the body then wrapped up in the kaross worn by the



dead person during life. The body was placed in a sitting position in the niche and the grave filled in and covered with a large heap of stones and branches. After the funeral certain mourning ceremonies were performed at the hut of the deceased person and next day all the huts were taken down and the people left the locality, after the heir had slaughtered a sheep. The hut of the dead person was left standing with all his possessions in it.

Dealing with the Nama Hottentots, Mrs. Hoernlé describes how cold water is thrown on the grave of a person newly buried and afterwards on the place in the hut where the body was lying before it was buried. This is to prevent the sickness that was there from spreading. The relatives of the dead person must on no account touch water but the other members of the kraal wash their hands in cold water. Purification rites, undergone by the relatives, include sweating under karosses, marking on the stomach with soot, and eating. The removal of the kraal from the place of death is no longer carried out. Special rites are applied to the widow or widower of a deceased person.

With cultural advance and the rise of the higher types of religion, burial rites among nomads have tended towards simplification and the final results, among Mohammedan tribes especially, are far removed from the elaboration which we have seen was characteristic of ancient Egypt. The Muslims generally, according to Ratzel, bury their dead quickly, without any care, except to lay the dead man's head towards Mecca. Their cemeteries are not walled and paths cross them in all directions. Among other nomads though the dead are usually buried, they are sometimes left exposed, while criminals who are killed or enemies slain in battle are left to be feasted on by animals.

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## XI

# ECOLOGICAL DIFFERENTIATION AND CLASSIFICATION

Introductory—Ecological Nomenclature—Fishermen and Seamen—  
Craftsmen and Artisans—Sorcerers, Priests, and Professional Classes—  
Traders and Merchants—Rulers, Nobles, and Aristocrats—Slaves and  
Serfs—Peasants—Bibliography.

### INTRODUCTORY. ECOLOGICAL NOMENCLATURE

WE have now reached a stage when, without attempting to force things in any way, and without stressing any one of the terms of the environment—function—organism triad more than another, it is necessary to inquire somewhat more closely into the general question of the ecological classification of mankind. So far the matter has been simple. The environmental and therefore ecological differences between food-gatherers and food-producers are so great that these form very natural main ecological divisions, giving us, at the outset, the beginnings of a dichotomous system so much favoured by those whose business it is to classify. Again, the ecological differences between pure agriculturalists and pure pastoralists are very great, so these form natural subdivisions of the food-producers. Unfortunately, as we have seen, the subdivisions very seldom are quite pure, for agriculture and pastoralism tend to mix, and indeed, very probably were united from the very beginning. Still there have been many advantages in treating the two subdivisions separately. Now while the untouched environment of wild animals and plants, and the environment of cultivated plants and the environment of domestic animals are all three very distinct, there are other environments (brought about mainly by increasing complexity of social organization) which cut across communal or political boundaries. They still depend on environments, each of which is distinct from all the others, but the environments are largely artificial or social environments created by man himself. An example of this has been dealt with in the last chapter in the age-grades which cut across the boundaries of family or clan and apply to the whole tribe. Various

'secret societies' or similar associations do the same thing. Each of them has its own social environment. Before we go on to consider such ecological groups it may be well to define more precisely than has so far been done the various social anthropological groupings.

The term *community* is best used with the widest possible connotation for any group of individuals large or small. The smallest community is the *family* which, in the narrowest sense, has the same meaning everywhere, viz. the group consisting of father, mother, and children. Complications commence when we have to consider polygyny and polyandry, and still farther when more or less distant relatives, on either the father's side or the mother's side (unilaterally), or on the sides of both parents (bilaterally), are also included. Without entering into too many details the term *enlarged family* may be used for such groupings. The *clan* is the next largest group and has been defined as an exogamous division of a tribe, the members of which are held to be related to one another by some common tie, it may be belief in descent from a common ancestor, common possession of a totem, or habitation of a common territory. Clans are either matrilineal or patrilineal.<sup>1</sup> The clan may be regarded in a sense as the widest extension of the enlarged family, but it includes more than this. It has functions of government and social organization, particularly as regards marriage, that are much wider.

The term *sept* has been applied to splits within a clan. A sept may develop into a separate clan or several septs may unite (Thurnwald, 1932). The term *moiety* is one applied to a division of communities in Melanesia, Australia, and North America. It transcends the boundaries of the clan or the tribe, and forms part of the 'dual organization'. The communities are divided into distinct moieties which play a definite part in the life of each community particularly in the regulation of marriage. (See Rivers, 1924, p. 27.)

The term *phratry* is applied to certain groupings of clans

<sup>1</sup> Lowie (1921) uses the term *sib* for the *clan* of British anthropologists and defines it briefly as a unilateral kinship group (either *mother sib* or *father sib*). Most American anthropologists apply the term *clan* to the *mother sib* of Lowie and the term *gens* to the *father sib*.



within a tribe. The clans within a phratry combine for social or economic purposes. The *tribe* is a larger group, not exogamous, speaking a common dialect, having a single government, usually inhabiting a common territory and acting together as one organized whole for purposes of warfare, &c.

Beyond this anthropology hardly concerns itself with the more complex groups such as the nation or state, but sociology steps in with a further nomenclature of its own.

Perhaps the time is hardly yet ripe for any very elaborate system of nomenclature in human ecology. It must be confessed that, in the opinion of many, more harm than good has been done to the subject of plant ecology by premature attempts to over-elaborate its terminology. Nevertheless, if terms are used to clarify ideas and make distinctions clear it is well that they should not be used without exact definition.

The term (ecological) *division of mankind* has already been used for food-gatherers and food-producers, while the agriculturalists and pastoralists are regarded as, not very distinct, subdivisions of the latter. Perhaps seamen and fishermen, still to be dealt with, might be added as another subdivision, though here they are regarded only as a *class*. The term *class* is applied to ecological types which form *part* of the community, e.g. a priestly class, an artisan class, &c. This is following popular usage more or less closely, but the necessity for precise definition should be increasingly clear. Where the whole community is more or less involved in a common mode of life there are no separate classes, but the community may either belong to one of the fundamental subdivisions (cultivator or nomad) or it may be a unit of a larger community, e.g. a mining town or fishing village in a county or state. In the latter case the smaller community, though not itself subdivided, shares the rule, laws, interests, &c., of the larger community. It is not independent.

When the distinctions between classes in a community are emphasized by being made part of the religious system of the people concerned as among the Hindus of India, then the classes become *castes*, but this term is not necessary for ecology in general and had best be restricted to India.

The term *guild* (or *gild*) is used for a subdivision of a class, e.g. a guild of smiths belong to the class of artisans and crafts-

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men. Further discussion of guilds had better be postponed until examples of them have been dealt with, and (following the practice adopted in previous chapters) general discussion, except for incidental references, will be postponed until the more important particular facts have been recorded. Space will not permit of any exhaustive treatment of all the separate classes of communities, or of any detailed account even of any one of them, but a sufficient number will be examined to give an indication of how human ecology must develop. Fuller and up-to-date particulars may be learned from Thurnwald's recently published five-volume work *Die menschliche Gesellschaft*, or others mentioned in the Bibliography.

#### FISHERMEN AND SEAMEN

This class, as already mentioned, though in some cases it forms a section of the community, and therefore is a true class, in other cases involves the whole independent community and is therefore comparable with the divisions already considered.

Man's relationship to water is a subject full of ecological interest. Certain aspects of it as it affects types like the pastoral Hottentots have already been described. The theory of Cherry may also be called to mind (see pp. 134-6). Whether he is right or not in believing that a semi-aquatic mode of life on the sea-shore exercised an important or even dominating influence over man's very early evolutionary history, there can be no doubt that, in much later times, life on the sea-shore, or on the margins of lakes and rivers, has tended to produce distinct ecological types. We have seen that fishermen, even at the food-gathering stage, tend to differ from the inland hunters of wild animals, e.g. among the Andaman Islanders. Fishermen on the whole lead a more settled life like the agriculturalists. The animal life of the water is the main source of food supply and the water front is generally comparatively safe when protection against enemies is required. The people who possessed the Maglemosean culture in Mesolithic times lived round the Baltic, probably on rafts. The pile-dwellings of Neolithic man, or similar habitations, have lingered on in many tropical regions until the present day. They are found in South America, Asia, In-

onesia, Melanesia, and Africa. In Europe on the lakes of Switzerland and in the British Isles and elsewhere they were common until well into the Christian era; indeed in Ireland such 'Crannogs', as they were called, were in use in the times of Queen Elizabeth.

In Africa, at the present time, a slightly different type of dwelling is represented by the floating houses of the Bakene, described by Roscoe (1915). Their houses are built either on the floating roots of papyrus on the sunny waters of small lakes or in the forest-like growth of papyrus in the rivers flowing into the Nile. On the lakes the huts are exposed to view, though always at a safe distance from the shore. They can be reached only by means of canoes. On the rivers the huts are concealed by tall papyrus and are reached by tortuous water tracks. Protection is the main object. The only means of getting from house to house is by canoes, many of which, according to Roscoe, are mere wooden shells capable of supporting a child only; but even small children of four or five years old are expert in handling such canoes.

The water, therefore, not only supplies this class of mankind with their main food supply through its animal life, but it also provides them with an easy highway for communication.

The mode of life of fishermen has had, once more, an important and determining influence on their ecological characteristics. It has led to their segregation and differentiation from other ecological types. A fisher class, or community, while coming into contact with neighbouring classes or other communities through their trade in fish, which they barter for other food and articles they require, tends to remain isolated. Their whole behaviour from the Stone Age onwards has been to cut themselves off, to live in dwellings that cannot easily be invaded, to keep themselves to themselves. At the same time their mode of life has led to co-operation, discipline, and solidarity within the group. This, in turn, and in the course of an evolutionary history extending over thousands of years, has led to a more and more effective conquering of their environment. The progress of culture in this group is reflected, as usual, in the development of their main cultural accessories, the means they adopt for transport over the

water. The first means adopted by primitive man to keep himself afloat was the raft, and probably a floating log, being the simplest and most obvious, was the first kind of raft. The Tasmanians used a raft made up of three cigar-shaped bundles of bark tied together. The rafts of the Paviotso Indians are very similar. The hollowed log or 'dug-out' is superior in speed but inferior in carrying power and stability. Yet it represents a certain degree of advance, though it did not oust the raft completely. The 'dug-out' is limited in its size by that of the largest trees that can be hollowed out. The raft, on the other hand, can be enlarged by attaching squared planks together. On this a raised platform can be constructed. Homer, in the *Odyssey* (Book V), describes in detail the construction of a vessel of this type. From the more primitive types of flat raft the various flat-bottomed vessels, still in use, have been evolved by building up the sides and shaping the bows, e.g. the sampan, the junk, the punt, and the lighter.

Dug-out canoes made from a single tree have been found associated with Neolithic culture from the Lake dwellings of Switzerland and from the peat bogs of Ireland and estuaries of England and Scotland. From the dug-out, the type of canoe or coracle made of bark or skin stretched on a framework was probably evolved. There are two distinct methods of construction, both still in use: (1) by first fastening together the outer shell and fitting in the strengthening framework later, and (2) by first constructing the framework and then fitting on the outer shell. The primitive method of stitching or tying the parts together gave way to methods of fastening by wooden pegs or pins, and ultimately the outside framework was composed of thin planks instead of bark. A boat is said to be 'carvel built' when the planks are laid edge to edge so that they present a smooth surface or, as is more usual, 'clinker built' when the planks are made to overlap.

For propulsion the pole, paddle, oar, and sail mark successive stages of evolution. The rudder and helm were relatively late inventions. Even as late as the time of the Phoenicians, steering was carried out by means of two broad oars placed near the stern.

The beginnings of navigation almost certainly took place



on rivers, lakes, and along sheltered shore lines, and fishermen were probably most actively concerned in its early progress. Ecologically, however, it is important to note that, almost from the commencement, other classes besides fishermen were concerned with navigation. Water, as we have already mentioned, is not only the habitat which supplies man with food in the form of fish and other water animals, but it is also a natural path for communication. While fishermen, as a class, have tended to favour isolation and a peaceable or purely defensive attitude, like primitive cultivators, those who developed water as a highway have been of a different type. They have developed as traders on the one hand, and later on as fighters, slavers, or pirates on the other, thus showing an exact parallel to the land nomads dealt with in the last chapter. It is true that seamen must have learned much of the art of navigation from fishermen, and throughout the course of history many fishermen developed into seamen or sailors, yet fundamentally there is a distinct difference between those that look to the sea as a source of food and those that use it as a means of communication.

To understand the development of sea-power it is necessary to go back once more to the archaic civilization of the Near East. We have seen how the earliest cities of Mesopotamia grew up as sacred cities round the temples of the Mother goddess during the fourth millennium B.C. The sacred city was also found in Syria and Palestine long before historic times. The Phoenicians of those regions were a people who, according to their own traditions, as recorded by Herodotus, migrated from their original home in the Bahrein Islands and west shore of the Persian Gulf by way of the Dead Sea into Syria. This is the first record of a sea-going people, but their movement probably formed part of a culture movement from Sumer to the Red Sea and Egypt. The Phoenicians were peaceful traders. The sacred city also spread eastward to India and Java. The Sumerian city-states and Sumerian civilization was ultimately supplanted by the Babylonian Empire of Hammurabi and Babylonian civilization which lasted for 1,500 years. The whole of this civilization of Mesopotamia reached an astonishingly high economic level, involving extensive trading and highly organized

industry and commerce and a banking and credit system far in advance of anything seen elsewhere, even in Egypt, until much later times. It all centred round the temple. Much of the Babylonian culture through its direct influence on the Jews and indirect influence on the Greeks has become world wide.

The ancient civilization of Egypt is equally imposing. To a large extent it was independent in origin though Dawson (1933), who is here being followed, suggests that it was subject to the fertilizing influence of Asiatic civilization. Egypt became a single unified kingdom with its whole life centred in its Pharaoh who was regarded as divine, being the living son of the Sun god. Egypt maintained close commercial relationships with the Aegean and Syria, the Red Sea region and southward to Somaliland, for the purpose of obtaining gold and spices.

During the last quarter of a century the researches of Sir A. Evans in Crete have thrown a flood of light on a third of the ancient civilizations—the Minoan or Aegean which was in origin a maritime expansion of the archaic civilization of the Near East. There are three periods of Minoan Culture: (1) Early Minoan corresponding to the Old Kingdom of Egypt 3200–2100 B.C., (2) Middle Minoan = Middle Kingdom of Egypt, 2100–1580 B.C., and (3) Late Minoan = New Kingdom, 1580–1200 B.C. It was in this eastern Mediterranean civilization that the early sailors learned to sail farther afield and no longer hug the coast lines. Up till quite recently it was held that the Greeks learned their navigation and their sea trading methods from the Phoenicians. It is now known, however, that the Phoenicians of early Greek history were only handing on to the Greeks this ancient Mediterranean or Aegean culture. It was a very rich culture and it owed its prosperity to trade and the control of the sea-routes of the ancient world in the East. The earlier period shows abundance of gold, ivory, and jewellery, but during the second period the great palaces of Cnossus and Phaestus were built, the former covering six acres of ground. It had a drainage and sanitary system which was in advance of anything up to modern times. The life of the inhabitants as illustrated by the wall frescoes was extraordinarily like that

of people of a century or two ago. Even the dresses of the women were more or less modern in style. At the close of the Middle Minoan period these palaces were destroyed, probably by nomadic invaders. It was at the same time that the pastoral Hyksos kings invaded Egypt and caused the downfall of the Middle Kingdom. The palaces at Cnossus and Phaestus were almost immediately rebuilt on a still grander scale. In its final period the Minoan civilization reached the climax of its development. It spread over all the Aegean Islands and on to the mainland of Greece, forming a Cretan empire ruled over by the King of Cnossus. Trade and industry and various forms of art flourished. Gradually the centre of power shifted to the mainland, particularly to Mycenae, and the end of the Aegean culture was not Minoan but Mycenaean. The Minoan culture came to an end, the palaces of Cnossus and of Phaestus were destroyed, and all the old Cretan centres were plundered about 1420 B.C.

There is evidence that the early Aegean voyagers crossed the Black Sea to South Russia, and along the Mediterranean Sea westward Aegean influence was felt as the Neolithic Age of Europe passed into the Age of Metals. In the parts where later the Phoenicians and Greeks colonized, Italy, Sicily, Sardinia, and Spain, those first beginnings of metal using cultures were seen. The Megalithic culture, to which brief reference was made in an earlier chapter, may have reached western Europe by sea from the East, though authorities are not all agreed about this. The great centre of its development was the Iberian Peninsula from where it expanded northward over western Europe.

The invasion of warrior peoples from the north, the ancestors of the Greeks among them, from about the year 2000 B.C. led to a general period of transition which lasted for many centuries. Gradually the Aryan peoples began to assume dominance. The Egyptians learned from their conquerors new methods of warfare, the use of the horse and war chariot, and, with its new professional army, Egypt became a formidable military power. Elsewhere throughout western Asia the same thing was happening. Powerful military states were emerging of which the most important was the Hittite empire with its centre in Cappadocia. This was the

great rival of Egypt from the fourteenth century B.C. It was based on the older city-states of the Mesopotamian type, but was dominated by a military monarchy. In Europe this was the Mycenaean period of Greece, and the 'Bronze Age' in the Continent as a whole. About the close of the thirteenth century (according to Greek tradition from 1192 to 1182 B.C.) was the time of the Trojan War. At one time this war and the fall of the Hittite empire and the general turmoil of that time in the eastern Mediterranean was supposed to be due to invasions from Thrace at the beginning of the Iron Age. But, according to Dawson, these great movements seem to have come not from the land but from the sea, and were due to Mediterranean peoples known to the Egyptians as the 'Peoples of the Sea'. Beginning as pirates and mercenaries their movements gathered strength. The Trojan War, the Hellenic colonization of Aeolis and Ionia, the Philistine settlement of Palestine, the final decline of the Mycenaean culture and the Dorian invasion of Greece and Crete were the results. Space does not permit of our following further the story of the expansion of ancient cultures and of the early beginnings of the conquest of the sea, but a word or two may be added regarding the vessels used. The earliest figures of ships among the Egyptians go back to about the year 3000 B.C. Some of these were large enough to transport cattle and were propelled by twenty or more oars. War galleys were also in use. Sailing ships are depicted, the earliest with a peculiar double mast joined at the top.

In classical times the trade of the Mediterranean was shared by the Greeks, from whom most of the details regarding the construction of ancient ships have been learned. More than three banks of oars were used. The trireme was succeeded by the quadrireme, quinquereme, and so on up to, it is claimed, as many as sixteen banks of oars, though how these could possibly have been arranged remains a mystery.

The Romans, to begin with, were not sailors, though they doubtless had some experience of the sea before the first Punic war. A Carthaginian quinquereme which drifted ashore was their first model, and after initial failures their victory over the Carthaginians at Mylae in 260 B.C. gave them the command of the sea. Imperial Rome depended



on an overseas supply of food, and the Roman roads, as well as the Roman fleets, made possible a world trade unequalled up to that time. Long voyages were undertaken. A direct (not coastal) sea route was opened up from Egypt to India.

During the early centuries of the Christian era the Mediterranean remained the main centre of naval activity. Meanwhile, in the north, the Vikings were developing a sea power all their own. The Vikings were the descendants of the Nordic races which invaded Denmark and Scandinavia from the Steppe regions of eastern or central Europe about 3000 B.C. Originally they were pastoral nomads, but around the Baltic they lived largely by hunting and fishing and picked up the art of navigation in that way. They finally became typical nomads of the sea, fighters and freebooters. Their ships were strongly built and were propelled by oars and sails. The large ones had a crew of 240. By the ninth century A.D. they had invaded the Mediterranean. They even crossed the Atlantic to Greenland and the shores of North America, where they formed temporary settlements. During the course of the ninth century their raids developed into permanent invasions. By A.D. 886 the Danes had conquered part of England. The Vikings held the Orkney and Zetland Islands and, for a time, most of the north of Scotland. In A.D. 911 Rolf the Ganger, led an expedition which settled in Normandy. Their descendants conquered England in 1066, and the Duke of Normandy became King of England. But we cannot devote more space to the consideration of the well-known facts of history.

Enough has been said to illustrate the essential ecological characteristics of those who go down to the sea in ships. Fishermen, to begin with, were purely food-gatherers. Lakes, rivers, and the sea supplied them with their main source of food. Like other food-gatherers, they were and still are peaceable, kindly folk who only desire to be left alone to live their lives in their own way. But the sea is not only a source of food supply. It is also a great highway of communication; and the nomad type, taking advantage of the inventions of fishermen and improving them greatly, building stronger and better ships and using them as instruments

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of war as well as for purposes of trade, have conquered far and wide, have established colonies and permanent settlements and profoundly modified the course of man's history.

#### CRAFTSMEN AND ARTISANS

The arts and crafts of early man and modern primitive peoples have already been discussed to some extent, but little has been said about any separate ecological classes, whose function it is to deal with these, and whose mode of life is thereby modified. In most of the examples quoted in previous chapters, arts and crafts were not the work of any separate class, but were undertaken by any individual who felt inclined, whenever he or she had leisure to devote to them. There tended to be a certain division of labour between the sexes, though even this was probably largely a matter of custom or convention and varied among different peoples. People became expert by specialization and even among primitive peoples a certain amount of specialization has developed. Thus, according to Lowie (1929), in northern South America one tribe builds canoes, another weaves hammocks, a third supplies both its neighbours with cotton, while still another has the monopoly of manufacturing curare, the arrow poison. In these cases specialization has gone to an extreme. More usually special work is the duty of a class within the tribe, but such distinct classes of workmen (or women) show all possible kinds of variation, as regards their relationships to the rest of the community.

Sometimes special skill in various arts or crafts belongs to certain families, being handed on from parents to children with the secrets carefully guarded. This is fairly common in Melanesian countries. In such cases special knowledge may be lost to a tribe if the families possessing it should become extinct. Elsewhere there are special guilds of the artisan class devoted to special trades of which pottery and metal work are the commonest. The status of such guilds varies greatly. The making of articles of special importance to the tribe as a whole is commonly associated with magic rites, and this tends to give a standing of importance to those allowed to practise them.

On the other hand, it has frequently happened among

relatively primitive stratified communities as well as among more civilized, that specialized work has been assigned to a slave class or to conquered peoples that have been reduced to a condition of slavery. Throughout the history of civilization the warrior, ruling, aristocratic classes have exhibited a tendency to despise manual labour. But, as Lowie (1929) rightly points out, there is little consistency about this tendency.

‘The blue bloods of East Africa herd and milk cattle, not merely with industry but with fanatical devotion. So, in the Middle Ages, a French gentleman suffered no loss of dignity as a glass blower. Again, tanning is surely a worthy enough occupation in the abstract, and in North America a woman, expert in dressing skins, was a highly prized mate. Yet in various parts of Africa the tanners form an outcast class.’

Similarly there is little consistency in the division of labour between the sexes. In one part of the world, or among some tribes in other parts, spinning and weaving is the work of women, while, in other parts or among other tribes, it is regarded as the proper work of men. In Samoa the men do the cooking, usually considered women’s work. As Lowie remarks, there is no logic about the whole business. Perhaps, however, it would be better to say that, until man’s ecology has been more fully analysed, it is difficult to understand the logic of it all.

A few examples drawn from Africa will help to make clear those trends among primitive artisans. Among the Baganda in former times the potters formed a distinct guild which had certain distinct privileges. The king had his own potters, and many of the chiefs also had theirs. In each case, whether they worked for the king or for the chief, the potters received land, and paid their taxes in pots, instead of finding the animals or the cowrie shells with which the ordinary peasant paid his rent. During the time the pots were drying no woman was permitted to touch them.

Special guilds of smiths were found among various East African tribes. The Kikuyu smiths (*Muturi*) are said to have come from a common centre of distribution at Ithanga on the south-western side of Mount Kenya (Hobley, 1922). In former times the ancestors of the Kikuyu dug out nodules

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of ironstone at Ithanga and also collected iron sand washed down by the rain from the hill. One section of the tribe smelted the iron, another forged it. At present, entrance to the guild of smiths among the Kikuyu requires an initiation ceremony, involving the slaughtering of a ram, the drinking of beer, the forging of a special iron bracelet for the would-be smith and one for his principal wife. Birth does not confer membership of the guild; the son of a smith also has to be initiated. All smiths are believed to possess magical powers, e.g. they can inflict curses or bless the weapons they forge, they can place a spell on a patch of forest to prevent any one from destroying it, &c. A medicine man has no power over a smith's magic. A woman cannot enter a smithy unless she is a smith's wife, and she can then come only to bring her husband's food. Among the Ukamba the original smiths all belonged to one clan, the Atui, but members of other branches have now learned the art and been admitted to the guild. Their powers here are more limited. They wear no distinct marks of their trade, and do not dedicate the weapons they forge, as is done among the Kikuyu.

Among other East African peoples, the smiths occupy a much lower position, being regarded more or less as serfs. The smiths of the Masai are known as *El-kunono*. The Kunono smelt the ore found in the bed of the Matapato river, or, at the present time, purchase the iron they work from the Swahili. The other Masai do not marry the daughters of the smiths. The very weapons forged by the smiths will not be handled by a Masai warrior until they have first of all been oiled and purified. The smiths even have a language of their own, a corruption of ordinary Masai but not understood by the latter. The smiths, among the Masai, unlike the rest of them, are not rich in cattle. Altogether they occupy a very inferior position. The same applies to the smiths (*Tumalods*) among the Somali. No free Somali will enter a smithy or touch a smith. The Tumalods are spread all over Somaliland.

It has been said that among primitive peoples there is no real distinction between artisan and artist. A potter is not content merely to make a pot, he goes farther, he contrives to decorate it. Similarly in basket-making, weaving, metal



work he not only makes an article but also tries to make it beautiful and in so far as he succeeds in doing so he shows himself an artist. This is true, but the artistic impulse is not confined to arts and crafts. It is connected with all man's activities. Religion and magic have played a part in its development. Similarly rhythmic movement is not only connected with labour into which it enters largely. Primitive man likes to work together with, and in unison with, his fellow men. But rhythm is also very obviously connected with many other activities, with song, dance, and poetry, and it has a deep significance in all the behaviour and general ecological development of mankind.

Even among primitive peoples the artisan class, or the guilds composing it, tends to cut across the boundaries, at least of the smaller communities, the clans. The articles made, of course, are commonly traded far and wide. With the advance of civilization a similar trend is apparent.

The term guild (or gild), which has here been applied to separate subdivisions of the class of artisans was used originally to designate the voluntary medieval associations formed for the purpose of affording mutual aid and protection to their members. They have sometimes been regarded as the continuation of the Roman *collegia* and *sodalitates*. Others connect them with 'sworn brotherhoods' or 'foster brotherhoods'. Vague references to such sworn unions go back to the ninth century. After the Norman conquest there were religious guilds in England, the members of which were sworn to assist one another in old age, sickness, poverty, and in other ways. Religious guilds were common on the Continent during the Middle Ages. Merchant guilds also arose about the same time, to assist in the regulation of trade. They played a more important role in England than on the Continent. Craft guilds began somewhat later and became very prominent throughout western Europe during the thirteenth and fourteenth centuries. A single craft guild usually comprised all the artisans belonging to a distinct branch of industry in any one town. They were controlled by officers or wardens, whose duty it was to see that the articles produced reached a proper standard. The hours of labour, the conditions of apprenticeship, and of admission to

the guilds were all defined by ordinances. Payments into a common fund were enforced and various religious observances, festivities, pageants, &c., were carried out. In England there was little in the way of conflict between craft and merchant guilds, but on the Continent during the thirteenth and fourteenth centuries the craft guilds rebelled against patrician governments and secured a large measure of independence. (For further details, see Gross, 1929.) Attempts have been made, without any very sound reason, to find connexions between those medieval guilds and modern trade unions. Historically they have no definite connexion, but ecologically they do have much in common, as all such associations must have.

In modern times new ideas of individual liberty and the value of free competition have arisen. The relationships between capital and industry have changed and nothing quite comparable with the modern factory system existed during the Middle Ages. Nevertheless, in the course of man's ecological evolution and differentiation, certain things have become more and more obvious. The mode of life remains the fundamental basis for ecological classification. With increasing complexity in social organization the mode of life of different classes within the community must come to differ also, leading to the ecological subdivision of the community. Each class must have a considerable degree of uniformity in its ecological characteristics, the same work, interest, feelings, and outlook. As the process of differentiation goes on the individuals composing each class become more and more conscious of this. A 'class-consciousness' develops, at first feebly but afterwards more definitely. Each class develops customs, laws, ceremonials, and an organization of its own, while continuing to fit into the organization of the larger community as a whole, more or less harmoniously. Perfect organic harmony in human communities, however, while remaining an ideal to be sought after, has rarely, if ever, been attained, at least when the community reaches any degree of complexity. A community is often compared with an organism.

In a sense it is true that the community is similar to the organism and it is a concept which, in the development of the

dynamic aspects of plant ecology, has had very fruitful results. The community has many holistic aspects which make it more than a mere aggregation of its component units, the individuals. Yet it is a comparison which is apt to mislead. If the evolutionary development of communities had proceeded, as plants develop from seed, regularly and harmoniously, if all the separate classes composing the community always worked only for the good of the whole, if individual men were always peaceful and unselfish, then the comparison would be more helpful. The ecological analysis we are striving after would then be a simple matter. But, as has already been repeatedly pointed out, a complete mixing of different ecological types has been brought about, over and over again, through the fact that man is not peaceful. Most modern communities owe a great deal of their complexity, not to any natural process of growth and development, but to the fact that one type of mankind has been conquered and subdued by another. Reduced to a condition of serfdom or slavery, the conquered have been fitted into the enlarged community, not as willing co-operators, but by force; and the subsequent readjustments have taken centuries to reach even the degree of harmony at present attained, which, it must be admitted, is nowhere near the ideal.

Yet it may very well be the case that, as explained in Chapter III, there are many far-reaching good effects from such mixings of different racial types, and the good may not be due wholly to intermating and crossing. A mixing of cultures, even a mixing or interchange of ideas in men's minds, often leads to new lines of thought, new inventions, new modes of life and ultimately to an all-round higher level of ecological behaviour and response. More than once in the course of history it has been shown that when a ruder type of barbarian has conquered a more peaceful, more highly cultured, but more stable and conservative type, and has even to a large extent destroyed its culture before settling down in its midst, later on, after a lapse, it may be, of many years, or even centuries, a new culture is built up containing elements of the old, but different from it and often far transcending it in many respects. The Greek civilization is a case in point.

## SORCERERS, PRIESTS, AND PROFESSIONAL CLASSES

Among the most primitive peoples a certain degree of social organization must exist, even if it is only within the enlarged family group, where the 'old man' is dominant. Moreover, as we have seen, among the food-gatherers, mental ability has always been respected. But the leaders do not constitute a separate class. However, social organization had not proceeded very far before the medicine man, witch-doctor, or magician made his appearance. Sometimes the chief of the tribe was also the magician, but this was not always the case. If the offices were divided, the witch-doctor was sometimes the more powerful of the two. The functions of the chief were such as all men could understand and appreciate, but the magician dealt with unknown and mysterious forces. He was detached from the family group and, in a sense, almost from the community as a whole, yet paradoxically, because of his detachment, his influence over communal life was all the greater.

The importance of magic in the life of primitive peoples has already been dealt with but, at present, we are concerned, not with its influence on the whole people, but with the class whose special function it is to deal with magic, the magicians themselves. The details of their magical practices, recorded in the now voluminous literature of anthropology, are extraordinarily varied and full of absurdities, yet they do have certain common characteristics. They prefer to work in secret and jealously keep their methods to themselves. This is partly, no doubt, because they fully realize that their power is effective only in such proportion as it remains mysterious; partly it is to prevent rivals or enemies from counteracting their efforts. Where they use natural means to bring about the desired effects, as in their use of medicinal or poisonous herbs, they still interpret the results as due to their magic. The poisoned arrow kills because it has *mana*. It is a powerful charm. The medicine man applies remedies. Some of them are quite effective but, according to him, it is not they, but he, by his magic, that effects the cure. They 'charm' the disease by the *mana* they possess but do not cure it as we think of a cure.

Yet it is difficult to believe that the magician always



deceives himself as completely as he succeeds in deceiving others. The rainmaker goes through all the necessary rain-making magic, but, as a rule, he is careful to study the sky at the same time and wait for a sign of gathering clouds before he commences. Even among primitive peoples the magician is an 'intellectual'. He is superior to his fellows in brain power. He has to be, or he would soon fail to hold his post. Among primitive peoples who have no religious beliefs beyond fetishism or nature gods, there tends to be a certain degree of differentiation between medicine man and sorcerer or witch-doctor. This applies, for instance, to the various Bantu peoples of Africa. The medicine man is a healer who mixes in magic, but possesses a good deal of empiric knowledge of herbs and remedies which he uses, often quite effectually. The witch-doctor is purely and simply a caster of spells. His influence is maintained mostly by the terror he inspires supplemented, in part, by the fact that he can, on occasion, if he is sufficiently expert, neutralize the spells of others. It would be unfair, however, to condemn him altogether. His powerful influence, if used for good, can maintain law and order in the community. That is why his influence is often greater than that of the chief. Entrance to this earliest of all the professions demands a long course of training. To a large extent it tends to be an hereditary profession because the medicine men and witch-doctors prefer to hand on their secrets to their own sons, but this is not always possible. Pre-eminently it is a question of sufficient mental ability and if that is absent no one is likely to qualify. Magic is a very powerful thing for the savage, and it is considered only right that those who are allowed to deal with it should handle it with care and should know what they are about. The magician is hedged round with all sorts of tabus. In some cases he is not allowed to marry and, in most cases, he must refrain from sexual intercourse when about to perform his magic rites. There are many other tabus, e.g. food tabus, &c., and failure in his magic is easily explainable by some transgression of tabus or failure to observe some necessary detail of ritual procedure on his part. The magic itself, of course, can never be at fault, though it may be counteracted by still more powerful magic.

The inter-relationships between magic and religion have already been discussed. The priest has to represent the people in their relationship to their gods or goddesses. Such an important function demands much ceremonial and the rites, as we have seen, might include sacrifices. The priests also interpret the wishes of the gods. In addition to this, many of them used to deal in spells or pure magic as well, and ritual continues as a part of most religions. In the sacred city of the ancient civilization the chief priest, as the representative of the god, was also the king. He was a priest king but first of all a priest. The god ruled through him. The resources of the city-state were all centred in the temple, from which the government, commerce, industry, and everything else was directed and controlled.

The temple was also the centre of all intellectual life. The art of writing, the calendar, the study of the stars and mathematics, all the learning of the ancient world originated there. The priestly class was the learned class. In Egypt, after the kingdom was established, the king unified all the local religious cults and became himself the divinely appointed head of the state as the son of the Sun god. In course of time, however, a professional priesthood grew up and increased in numbers. From the Eighteenth Dynasty onward they became very powerful and were divided into ranks. The temples possessed large estates and grew very wealthy. The priesthood was concerned not only with its purely sacerdotal functions but with almost every other type of intellectual effort. They dealt with all the arts and sciences known at that time, and practically the only education available was received at their hands. They were the lawyers, doctors, teachers, and writers. This condition of affairs persisted, more or less, in Europe also throughout the Middle Ages, with certain exceptions.

In ancient Greece the kings, according to Homer, were also priests, though there were special priests as well. The same apparently applied to Rome, but when the regal system came to an end, the priestly functions of the king were transferred largely to leaders of the state. The head of the family in Rome made sacrifices on behalf of the family, and larger communal groups had their special priests. In Greece the

priests attached to the temples were always honoured but they did not form a specially powerful class. In Rome, though the priestly functions were more important, they were kept strictly under the control of the State as a whole. In fact, neither in Greece nor in Rome was there any distinct priestly power. There was hardly any distinct priestly class. Religion was an affair of the family or of the State. Without pursuing this analysis any farther it is now possible to summarize some of the more important characteristics of both magicians and priests.

1. The class, as a whole, has always been an intellectual class, its members being mentally superior to the rest of the community.

2. The class being, from the commencement, the only learned class, has been responsible for maintaining tribal traditions and laws. It has also been responsible for the proper carrying out of all ceremonial practices. It is, therefore, essentially a conservative class.

3. At the same time, because of its intellectual superiority, it has been responsible for the initiation of new departures. Being on the whole a more leisured class, not having to work to provide its own food, it has devoted attention to mental pursuits, and all the different departments of human knowledge and study have been mostly developed, throughout man's cultural history, by this class. It is obvious that this trend is opposed to the last mentioned and in other respects the class tends to show contradictory characteristics.

4. An intellectual class must of necessity have many bonds of union, if for no other reason than that the members are separated, by their mental superiority, from the common herd. They have recognized the importance of strengthening those bonds. Admission to the class has always been made difficult. Proof of the necessary standards of attainment have overridden mere ties of blood or other reasons for conferring the privileges of membership, though doubtless there has always been (as there is to-day) a certain tendency towards favouritism, as in the case of a father endeavouring to hand on to his son, if he can, the store of knowledge necessary to enable the son to qualify. The class in so far as it is united by common ideals, a common outlook and a

common standard of knowledge, cuts across all community boundaries, even racial boundaries. The intellectual everywhere recognizes and feels united with his fellow intellectuals.

5. Again, however, this trend is contradicted by another which is equally characteristic of the class. There have always been endless rivalries among the members of it. The magician not only seeks to control the workings of nature by means of his spells. He devotes quite as much attention to counteracting the spells of other magicians. In the same way the priest has always tried to persuade the people that his own particular god is superior to all other gods, or if, under a monotheistic system, all priests serve one god, then each one tries to show that his own temple is a better place for worship than any other. Even the members of any single sacred institution (whether temple, monastery, convent, church, or any other unified association with what should be a single purpose and aim) are seldom quite harmoniously united.<sup>1</sup> There have been few more bitter quarrels than those between different sects professing the same creed. Just as family quarrels are the worst, so disruptive tendencies in classes that are bound together by many common interests and common ties, while understandable from a detached holistic standpoint, show how difficult it always is to attain a perfect ecological balance and adjustment to a social environment that from the nature of things must go on changing and developing.

6. While the above-mentioned are all more or less general characteristics, contradictory though they often may be, there are some that do not always apply to the class as a whole, e.g. the idea of priestly asceticism. In discussing the essentials of magic, in Chapter IX, it was shown that the condition of the performer is an important element of it. Many restrictions and tabus are applied to him. It is interesting, therefore, to note that among heathen priests asceticism is most prominent when magic enters most definitely into their religion. Similarly in the higher religions where ritual plays an important part, asceticism is most often expressed, e.g. by the celibacy of the clergy, by fasting at intervals, &c.

In conclusion it is necessary to trace very briefly how this

<sup>1</sup> As an illustration read, e.g. Browning's *Soliloquy of the Spanish Cloister*.



class has expanded and altered with the growth of modern civilization. The process really goes back to ancient times when in Babylon and Egypt, as we have seen, the temple was the centre of all intellectual activity. 'The connexion between the laity and the temple was often a very loose one.' Thus it was possible for learning to extend beyond the stricter confines of the priestly class. At Alexandria, during the reigns of the Ptolemies, though the Museum, the first real university of the world, was nominally dedicated to the services of the Muses, in reality it was more or less a secular institution. The names of Euclid, Eratosthenes, Apollonius, Hipparchus, Hero, Archimedes, and Hirophilus are associated with it.

In Athens and Rome the priesthood was never so powerful, and learning, when at its highest, had little direct connexion with religion. But the educational systems of Athens and Alexandria did not endure, and, with the rise of Christianity, the Church once more became responsible for all education, except to some extent military training. The rise of the guilds, already dealt with, tended to break through this monopoly, but though the guilds did play some part in building up the medieval university system, yet the universities developed largely on monastic lines, and in most towns grew up in the shadow of the cathedral. H. G. Wells has laid emphasis on the conceptions of self-abnegation and devotion which characterize the modern representatives of the learned priestly tradition.

'The doctor, solicitor, the teacher, the artist, all have their professional standards and repudiate commercialism.'

'There is a tradition of gratuitous service both in law and in medicine, and in Great Britain a quack can sue for his fees while a registered practitioner is restrained from doing so by his professional organization.'

'The element of devotion in this learned—priestly tradition is absolutely essential to the processes of civilization.'

In this class Wells would include not only priests and ministers of religion but teachers of every class, writers and creative artists, scribes and journalists, doctors, surgeons, and the associated professions, judges and lawyers generally, administrators, permanent officials, technical experts and, most hopeful, various, and interesting of all, the modern scientific worker. This is perhaps going rather far. Some

268 ECOLOGICAL DIFFERENTIATION AND CLASSIFICATION of them, e.g. artists and surgeons, might equally well be grouped with the previous class, the craftsmen and artisans. Emphasis, too, should be laid on other characteristics of the class besides their self-abnegation and devotion, e.g. their all too common rivalries and jealousies. Though it is their business to maintain traditions and customs and to hand on traditional learning, yet, at the same time, they have produced rebellious types who question tradition and seek to alter custom. As Wells points out, the priestly learned class has never been blindly obedient and disciplined. 'It was clerics, not Jew nor Moslem nor pagan, who broke the Catholic unity of Christendom.' On the one hand, then, by their respect for tradition, by their essential conservatism, by their devotion, this class maintains the processes of civilization, but, on the other hand, by the critical or questioning attitude of many of them, reforms and progress and great changes have been brought about. The latter process has been vastly speeded up in recent times through the astonishing progress of science and the technique of scientific research.

#### TRADERS AND MERCHANTS

Trading is much older than any class of traders. Even in primitive communities it involves much more than mere economic interchanges. It affects group psychology and social organization as well. Trade may be interchange between members of the same community or between different communities. The former is the more primitive, the latter more elaborate. Different methods of trading probably grew up in different cultures. The environment is here, as elsewhere in connexion with all man's ecological activities, of considerable importance. The nature of the trade is conditioned by the requirements of the communities concerned, as well as by their stages of cultural development. Primarily, exchange of economic necessities, food, clothing, weapons, probably formed the basis of trade, but at a very early period man began to lay more stress on ornaments than on what we now regard as necessities. To many savages ornaments, for instance, are more important than clothing, if not food.

The simplest form of trading is the exchange of gifts. There

is usually no actual bargaining, but, at the same time, a very strict sense of etiquette. The exchange must be reciprocal and the receiver must make an adequate return for a gift received; in fact, if he values his own prestige, the receiver usually endeavours to give back more than he gets. Barter is more of a business transaction. An ancient method of barter is the so-called dumb-barter or silent trade (*Stummer Handel*, see Frith, 1929). Herodotus mentions it as the method used by the Carthaginians in their trade with African tribes for gold. To this day it still exists in many parts of the world. One party deposits goods and goes away, the other party comes and examines them and deposits an amount of other goods of what it considers equal value and, in turn, retires. The first party, if satisfied, removes the goods offered in exchange and departs or, if not, remains until sufficient additions are made. Silent barter usually takes place between peoples of different cultural levels and is due to shyness or fear on the part of one or other of the participants.

Among primitive peoples collective journeyings in connexion with 'group-trading' of all kinds often have a very considerable social significance.

The system of primitive barter became modified into a system of buying and selling with the invention of money. Among primitive peoples a variety of articles are used as substitutes for currency, some useful, e.g. salt, tobacco, cloth, iron, hoes, &c., others merely ornamental, e.g. shells and feathers, but, as a rule, they remain substitutes rather than a true currency. In West Africa, however, the cowrie shell, salt, and cloth have developed into use as true currencies, having standardized values. This is possibly due to external cultural influences of Arab traders and Europeans.

True money is a selected product of trade used as a medium of exchange. All other goods are bought or sold for specified quantities of this medium. Hawtrey (1929) summarizes the characteristics required of money more or less as follows: (1) it must be the kind of thing that can be specified, it must be uniform and easily measured, (2) it must be capable of a sufficient degree of subdivision; (3) it must be easily recognizable by every one and distinguishable from imitations; (4) it

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must be easily portable; (5) it must not be subject to destruction or decay. All these qualities are best combined in the precious metals, especially gold and silver.

The importance of markets and market places from the ecological standpoint can hardly be over-estimated. Even at the lowest stages of agriculture, the village market place became the centre where everyday buying and selling took place. It was a meeting place where the news of the day was discussed and has continued so ever since. On a larger scale at convenient centres, special markets or 'fairs' were held, and in ancient times, and still more in more recent times, market towns have grown up around such centres. In the ancient Sumerian civilization, as we have seen, the temple was the great market and business centre of the city. To draw once more on Dawson's account:

'The recent excavations at the great temple of the Moon god at Ur of the Chaldees throw a remarkable light on the businesslike spirit in which the temple economy was conducted. In the temple archives have been found detailed accounts of the payments of the god's farmers and tenants, carefully balanced month by month, and for everything brought in, even down to six pounds of butter, a written receipt was made out on a clay tablet.'

'Moreover the temple was the bank of the community. Thus in the course of the third millenium there grew up in Mesopotamia a regular money economy, based on the precious metals as standards of exchange, which stimulated private enterprise and led to a real capitalistic development. The great merchant usually remained at home in the city which was his centre of business, and carried on his distant enterprises through an agent, who was entrusted with a capital sum and received a commission on the profits of his journey.'

All this sounds exceedingly modern, but the archaic civilization ultimately passed away and with the advent of the warrior nomadic races conditions changed. In the course of time new types of civilization were built up and new and still more extensive trade routes were opened.

The habits of discipline and orderliness, which led to the nomad's effectiveness in warfare, have made him also effective as a trader and merchant. The frugal habits and simple life of the nomad make for success when he enters into trade. Similarly, the habits of mobility, learned as he roamed over



the steppe regions, are what he needs when conveying his goods over long distances. Rapid and definite decisions and vigorous action, as we have seen, are often called for by the nomadic life. They are equally necessary for the merchant. It is one of the most interesting things to be noted in this ecological analysis how the fundamental characteristics of the primary divisions of mankind persist among the classes in more complex communities. The Jews, to begin with, were typical nomads, to-day they are the most typical traders and merchants.

#### RULERS, NOBLES, AND ARISTOCRATS

In primitive communities, while they remain more or less uniform and undifferentiated, there is usually one man who exercises the greatest authority. This may mean much or little. The 'old man' of the family group may be a complete despot or, on the other hand, in a larger group, the leader may be little more than a sort of *primus inter pares* among the elders. From this condition, with increasing complexity of organization, the difference in rank may become extreme, more extreme, indeed, among relatively primitive peoples than among more advanced. It is difficult, however, to ascertain how far this is the result of a natural evolutionary growth-like process and how far it is due to the mixing of different ecological types. The agriculturalists, on the whole, tend to show more of a communal spirit; they combine to cultivate their fields, they have communal property and communal ownership of land. As we have seen, their sorcerers or magicians have often most power and, in many cases, are also their chiefs. Where they have separate chiefs these tend to maintain their power with the assistance of their associated sorcerers.

The first rulers of civilized communities (the city-states of south-western Asia) were priest kings, but in spite of their marvellous efficiency in everything else these were not warlike. They were essentially peaceful and knew little or nothing of warfare. The same applies to the whole of the archaic civilization of the Near East. It was only after it was invaded and conquered by warrior nomads that it secured efficient military organization and leadership.

Now the study already undertaken of the pastoral nomads has shown us that their government has almost invariably been patriarchal and aristocratic. The head of each tribe is an autocrat and, on his death, his leadership descends to his eldest son, this law of primogeniture being also apparently more or less universal amongst them. As time went on the autocratic power of the chiefs became, to some extent, limited by councils of elders. The military efficiency of pastoral nomads has been sufficiently insisted on, and also the fact that the usual course of events in history has been their conquering of, and ruling over, more settled agricultural peoples. In the mixed communities which resulted, the conquerors became the rulers and nobility. The class previously dealt with (the merchant trader class) and this one, then, have often had a common origin and the nobility and merchant classes, in any community, do not differ so much as might, at first sight, appear to be the case. When the rulers and aristocrats have had a pastoral origin, they too retain many of their earlier characteristics. Perhaps most important among them is their inborn pride of race. They strive to maintain the purity of their blood and, through this, their class upholds its position. Its emblem is the sword, for this class is pre-eminently the one that makes fighting as well as ruling its function. The less desirable qualities of the pastoral nomad are also retained, the tendency towards indolence and the despising of the monotony of labour. They tend to leave the hard work of life to other classes whom they consider inferior. They are not even given overmuch to intellectual labours. The professional classes, as we have seen, have had a distinct origin, though in more recent times a class of professional soldier has arisen who, like other professional men, deserves to rank as an 'intellectual'.

It is unnecessary to mention all the characteristics of nomads as summarized in the last chapter, but such points as love of elaboration in clothing for ceremonial occasions, combined with simplicity for everyday wear, a love for horses, dogs, and other domestic animals, generosity, openhandedness and hospitality to strangers, faithfulness to comrades, love of freedom and independence, self-reliance and courage are points worth mentioning. While all this is, in the main, true

of the rulers and nobles and aristocrats, in more complex communities, it must be kept in mind that they are usually but are not invariably of nomadic origin. The class, from its high position, has naturally tended to attract to it and retain the most outstanding individuals from other classes of the community, though the task of entering it, if not born into it, has for long ages been made exceedingly difficult and sometimes impossible.

#### SLAVES AND SERFS

As Thurnwald (1932) points out, slavery has sprung from two distinct sources; the superiority (*a*) of one group to another, (*b*) of one person to the others.

Among the food-gatherers there are no slaves. Even among pastoral nomads, so long as they remain nomadic, slaves are captured, as a rule, only to be sold and are not retained. But among settled peoples, as the economic organization becomes more complex, there is an inevitable tendency for the industrial classes to be reduced to a condition of slavery in proportion to the development of power and efficiency in warfare on the part of the ruling and aristocratic classes. As we have seen, the latter have frequently attained their position by the conquest of settled peoples. Instead of slaying or sacrificing the vanquished, the conquerors set them to work to provide food and other necessities or luxuries for their masters. The results have been industrial development on the one hand, for the slave class worked harder than they would have done, probably, if they were left to please themselves (though some might argue against this view) and a rise in intellectual and military efficiency on the other hand, since the ruling and other non-slave classes were left free to devote their whole energies to their own special pursuits.

Among various primitive peoples slavery has arisen in other ways. Bondage for debt is a common cause and various breaches of tribal law is another. Voluntary or involuntary transference from one tribe to another, for any particular reason, may result in those transferred being forced to become slaves, at least for a time. An outcast from one tribe may be accepted as a slave by another.

In ancient Greece slavery was fully established in Homer's time. The slaves were not only prisoners captured in war, but free persons kidnapped by pirates or marauders and sold. Children were sometimes sold as slaves by their parents; and freemen, reduced to want, sold themselves. The insolvent debtor became a slave. Finally, slaves were bought from other countries. There was a regular systematic trade in slaves as in other articles of commerce. With the exception of Sparta, the slave class in Greece was, on the whole, well treated and all the Greek writers and philosophers appear to have regarded slavery as a perfectly right and natural thing.

In Rome slavery, as an institution, became still further elaborated. The free citizens of Rome, during her great period of expansion, were absent, largely on military duty, and the demand for slave labour increased enormously but was supplied by the very large numbers of captives taken in war. Later there was a large import trade in slaves from Africa and particularly from Asia. Not only were they used as tillers of the soil, but nearly all craftsmen and artisans, minor civil servants, physicians, artists, secretaries, teachers, accountants, business agents, actors, circus performers, gladiators, &c., were also slaves. There were *servi publici* as well as *servi privati*. Needless to say, all domestic duties were performed by slaves. In fact, apart from the work of ruling and fighting, the whole work of the State was more or less carried out by the slave class. With the rise of Christianity, the condition of slaves in the Roman world gradually improved and with the break up of the Empire it became replaced by the serfdom and villeinage of the Middle Ages.

The serf differs from the slave in that a limit is put to the power of his master over him. The duties and status of serfs were regulated by the State. The serf was not a mere chattel, yet, at the same time, he was not his own master. He had certain duties, usually connected with the cultivation of estates, which he had to perform. The absolute sway of the masters became checked by custom even more effectively than by law, and throughout the Middle Ages serfdom was the prevailing condition for all the lower classes. There were, however, different degrees of serfdom, from a state almost indistinguishable from slavery to a degree of freedom which



depended on the providing of a certain amount of labour and payments in kind, and outside that was unhampered. Gradually in Europe, except in Russia, where serfdom continued until the nineteenth century, with the decay of feudalism, the serfs attained the position of tenant farmers. In France serfdom came to an abrupt end with the Revolution.

## PEASANTS

While slaves and serfs form a general class that is fairly easily defined, there is a larger and still more general class, with a much longer history, which includes all the so-called 'lower social orders' that have not yet been dealt with. The best general term that can be applied to them is the term *peasants*. At an early stage of the evolution of the community, the leaders (priests or chiefs) assumed a dominance and the rest of the community a corresponding subordination. At times and for various reasons, as we have seen, this subordination became complete and resulted in slavery. This was particularly the case throughout the earlier development of civilized communities, especially Western civilization, though it applied to other parts of the world as well. Yet from the beginning the peasant class were not all slaves, and there were ways and means provided, even when slavery was at its worst, whereby slaves could become freemen. Accepting then the fact that the position of the peasant has varied greatly in the course of man's ecological history, that at times and in certain countries it has sunk to a condition little different from slavery and, at other times and elsewhere, it has risen to a position of democratic power, ecologically the peasant remains a characteristic and fundamentally important type. The primary and still most important work of peasants is the tilling of the soil. They retain the ecological characteristics of the class of cultivators, no matter how complex the community may have become.

Just as we have traced the persistent characteristics of nomads among merchants and aristocrats, so, in the peasant class we can easily distinguish the characteristics of the other great ecological division of mankind. The peasants have settled habits; they work hard and regard this as the normal condition of man; though, at times, they may com-

plain and be envious, it is not too much to say that, in general, they prefer work to idleness; they have an intense feeling and love for their homes. All this leads on to a general and characteristic habit of acquisitiveness. What they acquire by hard work they stick to. Unlike the nomadic type, whose wealth is so often produced by the work of others and who spends freely, the peasant becomes a hoarder.

Other characteristics of the primitive cultivators also persist. Women tend to remain more on a footing of equality with men. They also work hard. Among cultivators large families, who can contribute their share of work from an early age, are an asset. Peasant classes breed freely.

The philosophy, religion, and psychology of primitive cultivators enables us to understand much of the mentality of the peasant class. Many of their superstitious beliefs and practices recall the magic of their primitive prototypes. Even their religion remains of a primitive type.

In modern times the peasant class has not remained entirely on the land as agriculturalists. Peasants have entered the towns, in large numbers, where they form the bulk of the working-class population. The class of craftsmen and artisans, already dealt with, has been recruited largely from the peasant class.

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## XII

### GENERAL DISCUSSION

Introductory—Human Ecology as a Science—Ecology and Human Conduct—Human Ecology and Man's Works of Art—Bibliography.

#### INTRODUCTORY

**I**N this final chapter an effort must be made to gather the threads together, and examine (in the way ecology always attempts to do) the life of man as a whole. After having taken many excursions along different routes we return to the more general view-point once more. While in one sense, ecology is merely a view-point, in another sense it is the most complete science of life, since life is not a thing itself but a *process*, which of necessity continuously involves the environment. In this chapter it may be well to examine some of the progress already made, and a few examples of the kind of problems that have been or should be dealt with by human ecology as a science. As a view-point, human ecology obviously has an important bearing on human conduct, on the kind of question that is vitally interesting to every one of us, how to make the most of our lives and how to live happily. It supplies a working philosophy of life and conduct. A brief reference to this aspect of it will therefore not be out of place. Finally the ecological view-point and ecology itself affords a basis by which the value of all that man has ever accomplished, not only in the industrial arts but in the fine arts (painting, sculpture, architecture, music, poetry) and literature in general can be judged. It affords a scientific basis of criticism and evaluation not only of man himself but of all his behaviour and all his works.

#### HUMAN ECOLOGY AS A SCIENCE

Though the name 'human ecology' has not been much used, and, where it has been used, has often been applied in a very narrow sense, at the same time more definite progress has already been made in the subject than at first sight might appear. While, as we have tried to show in all the preceding chapters, any research in any of the human sciences must



necessarily have a bearing on human ecology, the subject itself, treated as a science, is distinguished by its holistic outlook and technique. It investigates as fully as possible the most essential feature of life, its relationship to the environment from which it cannot be separated. Though it is not necessary, it is natural to begin with a study of the environment and the more thoroughly and systematically the analysing of the environment is carried out the more fruitful the results of any ecological investigation is likely to be. But the same applies to the other terms of the environment—function—organism triad equally well.

Among the earliest of the studies on human ecology to be undertaken were the 'regional surveys' of Le Play and of Sir Patrick Geddes and their separate 'schools'. They are synecological studies and have tended to run on lines parallel to the extensive plant ecological survey work and mapping of vegetation communities that was taken up so enthusiastically about the beginning of the present century. Geddes was also a pioneer in such vegetation work and more especially through his pupil, Robert Smith, did much to further its progress in Great Britain.

In human ecology regional surveys vary a good deal in their general methods and scope. A considerable number have been undertaken as a preliminary to town planning. These naturally lay emphasis on natural features and the physical environment, but they take into account the industrial life of the town as well, and the mode of life of the inhabitants. Other studies have been made of existing conditions, by detailed and somewhat laborious investigation, e.g. house to house inquiries. They are of fundamental importance but the work involved makes it difficult to apply them on any extensive scale. More elaborate surveys have been undertaken largely by piecing together the information contained in various official or other reports combined with personal observations. Rowntree (1920) has published a social survey of the city of York for the year 1899. Bowley and Hurst (1915) and Bowley and Hogg (1926) have completed surveys of various other towns in the same way. They describe existing conditions for certain years.

More comprehensive than any of these is the work on

*Industrial Tyneside* by H. N. Mess. The information contained in this survey was collected during the years 1925-7, but it describes how the area has changed over a period of about a century. It is illustrated by maps, charts, and diagrams, and deals with the inter-relationship of the various towns in the area as well as the characteristics of each and of the inhabitants; with the numbers in different occupations, with the main industries in detail, with housing and town planning, health and health provision, education, organized religion, social service, and local government. The work was carried out by Mess as a director of a *Bureau of Social Research for Tyneside* which appointed a Survey Committee to assist him, and it represents one of the most complete works of its kind so far published. Still more elaborate is the survey of London entitled *The New Survey of London Life and Labour* which is not yet completed, and the recently published *Social Survey of Merseyside* (Jones, 1934).

Such surveys, however, as in the similar case of vegetation surveys, must be regarded as a preliminary for most intensive experimental work, and such intensive work though always to be carried out from a general ecological standpoint, must, perforce, be undertaken by specialists; or alternatively, the ecologist, when carrying out research work must abandon, for the moment, the view-point which enables him to regard the problem as a whole, must approach nearer to it, must himself specialize. Co-operative effort, if properly guided, properly directed and co-ordinated can, of course, accomplish more than can be done by any single worker.

A good example of such co-operative work is the recently completed ecological survey of the 'Poor White' problem in South Africa. The Union Research Grant Board was entrusted with the administration of funds supplied by the Carnegie Corporation of New York for the purpose of this and other researches in South Africa, and a representative Commission of Investigation was appointed to carry out the work. The report of this Commission has now been published in five volumes as follows: (I) *Economic Report*, by J. F. W. Grosskopf, (II) *Psychological Report*, by R. W. Wilcocks, (III) *Educational Report*, by E. G. Malherbe, (IV) *Health Report*, by W. A. Murray, and (V) *Sociological Report*

in two parts, (a) 'The Poor White and Society', by J. R. Albertyn, and (b) 'The Mother and Daughter in the Poor Family', by M. E. Rothmann. The Commission as a whole has published certain *Joint Findings and Recommendations*, which, if they are acted on, may have far-reaching effects. It is difficult to condense these findings and recommendations still further, though they occupy some thirty pages of the report. The Commission visited the poor in their houses, saw them at work or in idleness (which, as Dr. Malherbe puts it, was usually the case), listened to their stories of stress and vicissitude and collected hundreds of case histories and biographies which were checked by interviewing the local minister, teacher, shop-keeper, policeman, &c.

Thousands of children in over fifty different schools were given intelligence tests and the comparative method was pursued throughout. Questionnaires, which were sent to practically half the schools in the Union, covered 49,434 families. Maladjustment to changed environmental conditions is regarded as the main cause of poor whitism. Education in the past has been both insufficient and unsuitable. The mode of life of the rural population has brought about a type of mentality which makes response to modern economic conditions very difficult, and the older population, which has been subjected for the longest period of time to the influences developing the kind of psychology referred to, shows the greater degree of maladjustment to modern conditions and consequent impoverishment.

The need of lessened isolation and of better education is emphasized by the Commission. Dr. W. A. Murray, of the Union Department of Public Health, in his part of the report, deals with the effects of climate and diseases, and bodily nutrition. These are not regarded by the Commission as primary causes, though poverty and ignorance lead to lack of food and to wrong diet. This weakens resistance to disease and makes the problem more acute. The social and ethical traits among the poor whites are dealt with at length, as are the relationships between the poor white and the native, and the migration from rural areas and the adaptation of the poor white to city life, but for these and other matters the report itself should be consulted.

As time goes on the technique of the science of human ecology will doubtless be still further improved. The co-operation of specialists and experts with the British Broadcasting Company or news distributing agencies is a promising line of attack on various problems, which has recently begun to be developed. The ecology of the family has, in this way, been studied by Sir Wm. Beveridge and other members of the London School of Economics. After a series of wireless talks had been given a very full 'Family Form' of inquiry was widely distributed and, from those filled in and returned, statistics were made available covering over 20,000 families, thus enabling deductions to be made about change or persistence of occupations from one generation to another, about choice of occupations, about changes in family life, about married women's employment and other similar subjects. These results are all very important in themselves but the very modern methods employed in the obtaining of them is, from our present standpoint, particularly interesting.

There are many aspects of ecological research on man that can best be undertaken by those with a medical training—which in modern times is being made more and more ecological. This has already been illustrated in Chapter IV. It is when things begin to go wrong that the interdependence of life and environment is made most manifest. Anything approaching a full discussion of the ecological aspects of disease would have required a book to itself, but such phenomena as the seasonal variations in acute diseases (e.g. influenza epidemics) are familiar to every one, while slower changes in the character of diseases in general are an accepted fact which is not to be explained merely by changes in fashions of treatment or improved methods of diagnosis. Such problems are all essentially ecological and the solving of them, as well as the multitude of other special examples of maladjustments, requires special technique and a very special training.

The student of human ecology, for most of the problems that he will be called upon to solve, must be able to handle statistics, to understand the mathematical theory underlying their use, and particularly to know within what limits any correlations he establishes hold good. The correlation coeffi-



cient already referred to in Chapter V is as important for ecological studies as for any others. Its use has helped more than almost anything else to make ecology an exact science, but it has not, so far, been applied nearly as extensively as it should have been.

A reference to the work on Social Psychology, briefly touched upon at the close of Chapter V (see Young, 1928), will show how extremely varied are the various social problems that can be investigated. It should be kept in mind that they are both synecological and autecological, i.e. they concern the group as well as the individual.

Since ecology is ready to draw upon, not only the content, but the methods and technique of all other human sciences to further its objects, it is never likely to become stereotyped. It always tries to regard every problem presented from all sides, and is ready to adopt any line of attack that promises to yield definite results in the shape of new facts or a clearer understanding.

The examples already quoted, such as the detailed regional surveys, the ecology of the poor white class in South Africa, the ecology of the family in modern England, the ecology of diseases, &c., are only a very few out of the multitude that may with advantage in the future be investigated. A really detailed ecological classification of mankind cannot be given until the interaction of far more types with their environments have been studied. The pioneer type who, as we have seen, is mainly concerned with an unconquered unaltered 'natural' environment, the leader type who is more concerned with a social environment, the rebel, who refuses to subordinate himself to any environment, the genius, the painter, the poet, the musician, the philosopher, the philistine, the beggar, the tramp, the commercial traveller, these and many more differ from one another ecologically, and the differences between them can all be better understood once the distinctive environmental relationships of each of them are analysed. The ecology of feeble-mindedness, of delinquency, and of the criminal classes, &c., are subjects which have a special literature of their own, with which, once more, medical science is much concerned.

There is also a vast literature dealing with the ecology of

the family and sex-relationships, while the synecology of the clan and of the tribe and other communities large or small has received attention from anthropological science. Other associations or societies or organizations of various kinds cut across the boundaries of the smaller communities and even, in some cases, of the larger states, until they may become world wide. The Freemasons, the Y.M.C.A. or Y.W.C.A., the Boy Scouts or Girl Guides, the Red Cross Society, International Rotary, &c., are a few examples. While a good deal has been written about mixed blood peoples, the whole subject of their relationship to the parent stocks, which often constitute the most important part of their environment, is pre-eminently one to be investigated on ecological lines. In such a study the value of genetics, of psychology, and of medical science is sufficiently obvious. It is the kind of ecological investigation that can only be undertaken with any prospect of success through the co-operative effort of a number of specialists.

Space does not permit of our continuing this general survey any farther, but a somewhat fuller Bibliography is appended to this chapter. In the works there mentioned, many of those special ecological problems are dealt with.

#### ECOLOGY AND HUMAN CONDUCT

The ecological view-point regards life as an interaction between the environment and man as a living organism. Sometimes it concentrates on the environment itself, sometimes on man himself, sometimes on the interactions between the two, but finally it always endeavours to view the environment—function—organism triad as one definitely integrated whole. The result is a habit of mind, a mode of thinking, a general 'philosophy of life'. The ecological attitude of mind is one which is of great practical importance because it assists in the solving of the innumerable everyday personal problems of adjustment which are encountered by all of us. For a healthy life the environmental interactions with the organism must run smoothly. If they do not, the result is disease with accompanying pain, and, it may be, finally death. The 'smooth running' involves a multitude of separate processes of response on the part of the organism which have all to be

combined and integrated. Their rates must be so controlled that no single one runs too quickly or too slowly. A proper balance of all the reactions or responses must be maintained. Animals have in general a greater power of selecting their environments than fixed plants because they have greater powers of movement. It is a general biological law that all mobile organisms tend to select the environment which suits them best, but their doing so is largely if not entirely the result of environmental stimuli, if we use environment in its widest sense, and it must not necessarily be regarded as arising from any power in themselves of initiating any action which is entirely independent of the environment. What they do possess is the ability to respond to external or internal environmental stimuli, combined with a power of integrating those various stimuli, so that the result is a definite response or reaction or activity of the organism as a whole.

Marston (1931) (to whose work, brief reference was made in Chapter V) would restrict special integrative power to living organisms which possess a synaptic type of nervous system. Animals below the coelenterates, with an all continuous nervous system, according to him, show no activities of special unification in response to environmental stimuli. They generate no special 'integrative energy'. On the other hand, all higher organisms including man do show integrative activity and the study of this is regarded by Marston as the proper field of psychology. Consciousness he regards as a product of integrative activity. At the same time he insists that integrative psychology does not imply control of the organism by the environment, but, on the contrary, it shows or attempts to show that human beings possess the ability to free themselves from external environmental control and to use their environment to develop themselves in any way desired.

The position adopted by Marston is, up to a point, essentially ecological, so it is worth while pursuing our reference to his work a little farther though it is very difficult to do so concisely, and to understand his views adequately his book should be consulted.

According to him, each incoming external environmental

excitation must be reconciled with the internal activity of the organism and this is made possible by the integrating mechanism of the human nervous system. An integration involves a relationship between two or more elements and the simplest relationships between the whole organism and its external environment are those which he calls Dominance, Compliance, Inducement, and Submission.

*Dominance* integration means that the organism's self or tonic activity is in conflict with, but superior to, the phasic influences of the environment. *Compliance* integration refers to the situation where the self is weaker than the environmental influences and in conflict with them. *Inducement* integration represents the situation where the self activity and environmental influences are in alliance with one another, with the self in a position of superiority. *Submission* integration describes a state of alliance between self and environmental activities wherein the self activities are weaker than environmental influences. Thus the organism plays the role of dominating, complying with, inducing, or submitting to the environmental situation. Each of these 'unit responses' may be *active* or *passive*. Active dominance is aggressiveness and is shown when one fights or pursues and overcomes, passive dominance shows less aggressiveness and means successful resistance. Active compliance is engaging in some new and different activity so as to meet a stronger force, passive compliance is a giving in and stopping of some activity (though unwillingly) when the opposition becomes too strong and dangerous. Active submission is willing obedience in the doing of something active, passive submission is the willing ceasing of an activity. Active inducement is the active use of persuasion rather than force, passive inducement is where a person merely offers himself as a stimulus, e.g. the sight of a helpless infant will induce most women to submit to its needs.

There are also compound unit responses connected with the basic drives of which Marston recognizes three (hunger drive, erotic drive, and procreation drive). Thus in the hunger drive, there is first the compound unit response *Desire* composed simultaneously of passive compliance and active dominance responses, followed by *Satisfaction* a com-



pound unit response combining active compliance and passive dominance. An *Appetite* response is a simultaneous mingling of desire and satisfaction responses.

In the erotic drive, *Passion* is a compound unit response combining passive inducement and active submission while *Captivation* combines active inducement and passive submission.

In the procreative drive the complex unit response *Origination* consists of desire and passion combined and the complex unit response *Transformation* consists of satisfaction and captivation combined.

The *internal* determination of behaviour is termed by Marston and other psychologists *motivation*. Hormic stimuli for instance, being part of the organism's total functioning, are part of its motivation. The drives already mentioned are motives as are also the native integration mechanisms which determine what variety of unit response to the external stimulus situation shall occur. These two may reinforce one another or may be in conflict. A hunger drive, for instance, may be a motive for stealing food but a 'punishment motivation' may result in a compliance response so that the food is left alone. A great proportion of human conduct is controlled by the compliance motive. As for the other motives, Marston points out that a well-trained child learns during early infancy that he must *dominate* things and *induce* human beings and animals. Submission is the human motive underlying human companionship and organized society. The compound unit responses of desire, satisfaction, passion, captivation, origination, and transformation are also found in motivation. It is unnecessary for our present purpose to follow the analysis of integrative psychology in its application to sensation, thought processes, emotion and personality types. The first point of interest in it all lies chiefly in its attempt to classify the fundamental types of human behaviour. There are, according to Marston, only four types of elementary unit response. The second point of interest is the objective view of the nature of consciousness.

Since the subject is psychology, Marston's work lays emphasis mainly on the middle term of our triad, though, of course, it is forced to consider the other terms as well. It

represents a serious attempt to unify psychology as a definite objective science.

When ecology has succeeded in analysing the fundamental aspects of the human environment in a similar manner, then human ecology will also become still more definitely unified. The outline account of the environment given in earlier chapters is at least sufficient to show its complexity. Whether man, in his relationship to it, actively overcomes and conquers it or passively resists it with success (dominance), or actively or passively complies with it, or actively or passively induces it (especially the living and social environments), or, actively or passively, willingly submits to it, it remains not a simple unit thing but a very intricate whole, compounded of many separate elements. Our earlier descriptions have shown that the human environment has had an evolutionary history *pari passu* with man's own evolutionary history. This must be so since it is largely his own creation. The relationship of the primitive hunting food-gathering types to their environment is a relatively simple relationship, though complex enough in many ways. In most directions their response to it is one of compliance, if not submission, but they show the beginnings of the long-continued effort on the part of mankind towards dominance over things and inducement in relation to animals and fellow men. The environment of the food-gatherer is still a natural environment, for the most part unmodified by man.

Man's two great cultural achievements of plant cultivation and the domestication of animals, constituting two of his greatest triumphs in the way of dominance or inducement, have in the course of time completely changed his environment; for man's culture is something which is outside his body and can be handed on from generation to generation, while undergoing in itself an evolutionary growth and development. With this evolutionary change of the environment, man's responses, activities and behaviour generally have also undergone change. Even though the responses may remain fundamentally of the same nature, the units are differently combined and the results, as shown by man's action, are different. Now, just as on the purely physiological level, man's health depends on a more or less perfect adjust-

ment to his environment, so also on the mental side man's happiness and well-being depends on his living in harmony with his environment. The form taken by his responses to it depends not only on the external environment but also on the inner activities which constitute his self. If there is maladjustment anywhere, there arises a condition of things which, on the mental side, corresponds to disease or illness on the physical side. As soon as the *effects* of this maladjustment, though not necessarily the causes of it, are made manifest, unhappiness results. To put things right we may endeavour to change the inner activities of the self, with or without the help of a specialist in mental illnesses. Just as the doctor tries to alter the internal functionings of our bodies by seeking to alter the internal environment so also the psychiatrist endeavours to alter the inner activities of the central nervous system, and of the mind. Alternatively, we may put things right by altering the external environment. Man has a far greater power than that of any other animal of choosing his own environment. It is a problem which faces him all through his life, in countless small ways from day to day, and in more important ways at various critical or transitional periods in his life, e.g. choosing a profession, choosing a mate, selecting a dwelling place, choosing a particular type of social environment out of many that are possible, &c.

In modern times with the vast increase of mechanical inventions the complexity of the environment has become so great that a perfect adjustment to it, on the part of many types of personality, is found to be increasingly difficult. Where the natural response is towards dominance, i.e. where the environmental influences run contrary to the person's own self-activities and therefore require to be overcome, the strain often becomes too great. Compliance does not necessarily bring happiness. (The prisoner complies when he is put in prison, but he is not as a rule very happy about it.) In such cases, there is a natural tendency to choose a simpler environment, if that is possible, even if the choice is only for a time until strength is renewed. This is why, as we have seen, the busy city man likes to go fishing or hunting or camping or boating or even gardening—all of them representing a return to the simpler environments of the days

when all mankind was more closely in touch with natural unchanged environments. It is easier and often pleasanter to slip backward in the evolutionary cultural scale than to remain always at the top of it. The fact that some prefer not to slip back but to remain always in the forefront only shows that there are many different ecological types among mankind. Men differ widely in their essential natures and it takes all sorts to make a world.

The question of how to be happy is one that has always been of interest to men and women. In these modern days, to judge from the number of popular books that have been written on the subject—many of them by very competent psychologists—its appeal is as great as ever. Most psychological works give advice which, in essence, comes back to that of Socrates and it is to 'know thyself'. The ecologist has no fault to find with this. It is necessary to know oneself and endeavour to live in such a way as to be in harmony with one's essential self, but the ecologist would go farther and urge that it is equally important to know one's environment and live so as to be in harmony with it. It is just in this getting to know one's environment that ecology, while making full use of psychology, can add to its effectiveness and to its completeness as one of the most important of the sciences that deal with man.

#### HUMAN ECOLOGY AND MAN'S WORKS OF ART

Most of what is called criticism consists merely of the judgements of the critics, but criticism should also endeavour to interpret and explain. When the works of man are considered the ecological explanation of all those which serve an obviously *useful* purpose is sufficiently evident. They assist him in the conquest of his environment. The evolution of his bodily structure, as we have seen, has been arrested and, instead, an evolution of another kind, an evolution of a material culture has taken place outside his body. Step by step he has made the tools he uses, the machines he has invented, more and more effective. He has learned how to control the energy of Nature and make it serve his own ends and has found the task, on the whole, a much simpler one than to change his own self-activities or his laws and customs.



But the works of man are not confined to the industrial arts, they have not always been of a kind that can be described as useful in the sense of serving his bodily needs. All his works of fine art, all the architecture, sculpture, painting, music, and poetry he has produced, though they have a most profound usefulness, cannot be explained in such crude ecological fashion. Yet ecology, in so far as it makes for a deeper understanding of life has much of value to contribute to the philosophy of art, more than the more restricted view-point of psychology by itself can offer. It does so by insisting on the necessity for seeking to understand not only man himself but man in relation to his environment. That is what life essentially means. Art makes life clearer, more vivid, more 'alive'. By man's art his environment for him has become more distinctly and clearly seen, heard, and understood. Art intensifies and clarifies the whole of man's experience.

For the human baby the environment is utterly confused and almost completely chaotic. To begin with, an infant has no clear notion of what is self and what is environment. Even primitive man, as we have seen, identifies himself with his environment and, like a child, has but dim ideas of the significance of his relationship to it. The development of the individual as he passes through the various stages of his life-history and the evolutionary development of mankind results or has resulted in a clearer understanding and appreciation of the ecological position, and it is this process which the artist carries farther or makes more arresting and vivid than others do. There is an Art of Life as a whole which the ecologist, standing apart from it, contemplates and criticizes, but the individual artists come closer to it and deal with separate aspects of it. The practice of art has certain definite consequences. In the first place the artist himself is affected. His senses become more acute. He sees things which others do not see, he hears things which others have not heard. In the second place the artist uses the materials with which he works to produce works of art. He gives us an integrated interpretation of what he has seen or heard, and this has a permanence which his own original experience of it has not. This does not necessarily mean that he is solely concerned with the capturing and the rendering permanent of the changing

or evanescent beauties of nature. Environment, it should be remembered, is always used in its widest interpretation. Environment is largely a matter of man's own creating. Imagination always plays an important part in art (as it does in science), though art is not, as some have maintained, only concerned with a world of the imagination. Art, on the contrary, shows us the aesthetic realities of life. It 'interprets' life, and it idealizes. Its truths are thus felt to be universal truths.

It may be useful now to examine very briefly some of the different arts, but it should first be noted that not only are the producers of art concerned, but also the far greater number of those who find aesthetic pleasure in contemplating, studying, or experiencing of works of art. At least to some extent art affects the whole of mankind.

A painter, in painting a picture, puts on record his own reaction to some aspect of his total environment. He is not necessarily concerned with representing Nature accurately like a photographic plate but he does endeavour to make clear what he himself has seen or experienced. He does so by using lines and colours on canvas in various combinations. His composition has a unity of its own and it has to be judged by itself and as a whole. The harmonious integration of its parts and of its lines and colours, its vividness and clarity are what are important aesthetically and not necessarily what it represents in the common external environment. As regards its effect on those who view it, two things have to be considered—its direct effect on their senses, or the way in which it immediately stirs the emotions, and its less direct appeal to the imagination or to pleasant and unpleasant memories or associations. Sculpture, as an art, is similar to painting, but since it primarily deals with the human body, the environment in this case is more restricted, and at the same time, in certain respects, more intimate in its appeal. Being in three dimensions and 'form' having more importance, sculpture perhaps tends to appeal more to the intellect than the emotions, yet in its effect on the observer a figure carved out of marble may represent much more than a likeness of the human form or of its gracefulness and strength or beauty. It may show much of the mind of man, of his reactions and emotions, of his inner self; and the aesthetic pleasure in con-

templating these aspects of it is reinforced by the feeling of permanence given by the material used.

Architecture is something more than the art of building. A building must be fit for the purpose for which it is intended, but architecture makes a building also a work of art which expresses much of what can be expressed by the other fine arts, painting and sculpture, and even music and poetry. At the same time the fact that it serves a useful purpose adds to rather than detracts from its aesthetic appeal. The architecture of a building, if it is to be aesthetically pleasing, must show its adaptation to its purpose. It must express its function. A cathedral, a theatre, a palace, a block of modern flats, a steel skyscraper, all have their different functions and can all be made beautiful but this must be done in different ways. Architecture is a social art in a way that painting and sculpture are not. Buildings reflect more the life of people and their environmental relationships rather than that of individuals. There are lesser arts which have something in common with architecture in that they too are not divorced from utilitarian purposes. The potter, the weaver, the embroiderer, the carpenter, the goldsmith, the blacksmith, the tailor, the dressmaker or 'fashion designer', and scores of others, produce articles that are useful but also often highly 'artistic' and designed to give aesthetic pleasure. The ecological characteristics of those who are engaged in such work (the craftsmen and artisans) have been considered in the preceding chapter.

Music, unlike the plastic arts, is concerned with sound and hearing and with a succession of events in time. Sound is the medium by which emotion is not only expressed but also excited in all the higher animals, and even music (e.g. in the form of the songs of birds) is much older than man himself, not to speak of his art. Sound also, by man, has been made use of, in his language, as a means of communication with his fellow men—a subject which space limitation has prevented us from entering into, but one that has an ecological significance all its own. Music, as an art, opens up an entirely new world to us, a world in itself, different from all the rest of our environment (which is made known to us chiefly through our senses of sight and touch). It introduces to us

an aspect of our environment which, but for music, would have remained for ever unknown to us. It is an objectless environment. The most fundamental thing about music is the fact of its rhythm, and so many of man's functional responses and activities are of a rhythmical nature that music has a profound and very subtle emotional appeal. There are, of course, other things in music besides its rhythm. It contains all the features and qualities of all the sounds in Nature that ever reach our ears, the songs of birds, the cries of animals, the roll of thunder, the sighing of the breeze, the 'long ripple washing in the reeds and the wild water lapping on the crag' and, most of all, the sound of the human voice. These sounds in music, not in any crudely imitative way, but refined and beautified, appeal to our imaginations and to our almost forgotten memories of past experiences. We are alternately aroused, or stimulated, and soothed and satisfied.

While music cannot be specific in the way that language can, and the same music can arouse very varied and different feelings and emotions in the different individuals listening to it, at the same time, music has always had a unifying social effect. Primitive music is usually associated with dancing which, as we have seen, is similar in this respect. Martial music and the war-dance are functionally important when the necessity arises for troops or tribes to act as one. Apart from this, however, the emotions of those listening to music (or experiencing the effects of any work of art) in company with others are different in degree if not in kind from what they are when the individual is responding alone and by himself. His emotions in company tend to be reinforced by what has been called 'sympathetic resonance'. True aesthetic pleasure of all kinds is increased if it is shared.

Dancing consists of rhythmical movements of many kinds and is expressive of emotional or mental states. Among primitive people, dancing is usually accompanied by clapping of the hands or the beating of drums to emphasize the rhythm, and solo dancing is rare. The dance performed by a group has, as already noted, a socially unifying effect, and organized dancing takes place when such an effect is particularly required, e.g. at various ceremonial functions, transition rites, &c. Among many primitive peoples dancing is of



the nature of a religious exercise or is closely bound up with magical practices. Many primitive dances (as noted in an earlier chapter) are mimetic, but they are not all of this nature. Some dances are designed to increase sexual excitement, others give an opportunity for pleasurable exercise or for display (as in courtship dances) or for the working up of a state of hypnosis or frenzy (as in the dances of witch-doctors). Dancing, like music, therefore has both an individual and a social aspect, and in both it produces pleasurable or otherwise satisfying emotional states. The mimetic dances of primitive peoples, the dramatic dancing of India and Japan, and folk-dances generally (courtship dances, ritual dances, &c.), all have much in common with acting and dramatic art. Imitation is natural to man. He shares these powers of mimicry with many other animals. Early man, however, soon began to regard acting as a serious business. Dramatic ritual has a very deep ecological significance for all primitive peoples. It is intimately bound up with all their religious ceremonies and beliefs. From this to the great Greek, Roman, Elizabethan, or modern dramas may appear a big step, but it is one which has perhaps been more carefully studied than any of the other arts of man. Aristotle in his *Poetics* gave a history of the rise of the Greek drama from ritual choruses. The first real actor was a priest and the religion of the primitive agriculturalist, the worship of the Earth goddess and her divine consort, which we have already examined, was responsible for the real birth of the drama. The close relationship between religion and the drama continued to be exemplified in medieval times and later by the 'morality' and 'passion' plays.

As man, in the course of his ecological evolutionary history, felt compelled, he has modified the original drama to meet his needs. The result has been almost endless variation. At times it still continues (as in the ballet) to be associated with dancing. It may be acted by a single actor or by many. It may be poetic or prosaic or it may be a dumb show. It may even be shown by puppets or marionettes. As in the case of painting it is not necessarily to be judged as a photographic (or rather cinematographic) copying of life. Each drama is to be considered as a unit whole, as a complete work of art

and most of what has been said regarding other forms of art applies equally to the drama.

The full understanding of any drama together with the interest and aesthetic pleasure felt in the witnessing of its performance, or in the study of it, is greatly increased by the ecological attitude of mind. The dramatist creates for us a new world and the actors live for us a life in that world which we are able for the moment to share. Ecologically we find ourselves interested first of all in the plot, in the dramatic story and then we go on to find interest in the characters individually and in their ecological inter-relationships with one another, in their social and general environments and their responses, and finally we view the drama ecologically as a whole. Its vividness and intensity, its distinctness of emphasis on the essentials of the pictured relationships of environment and man is pure human ecology of a special kind. Like other forms of art, it makes clear to us truths that are felt to be universal and it helps to interpret for us life. It makes us 'aware' and we are thrilled by the act of discovering our new awareness. It clarifies for us all our own relationships to our own environment and it does more; it gives us new experience of environments which in our ordinary dull lives most of us are never likely to encounter in reality.

The drama and especially the modern drama from Shakespeare onward is regarded, by many, as primarily a form of entertainment. Like the 'novelette' of the domestic servant, like the adventure story beloved by all those whose daily task is anything but adventurous, it affords a means of escape, it takes us away for the time being from our normal environment and provides for us another life in place of our normal lives. Schopenhauer long ago pointed out that this is one of the things which all the arts in various and often very subtle ways perform for us, and for many it constitutes their main appeal. But as Edman (1928) points out, 'this theory of art as escape fails to take into account much that is true of aesthetic experience and is an insult to the more rich and positive aspects of aesthetic enjoyment and production'.

Finally among the works of man here to be considered, there is the vast accumulated record of his activities in the form of literature. It is a record of his culture in the widest

sense, and not only would much of his material progress and success in controlling his environment have been impossible without it, but much of his art as well would have perished at its birth. Its relative permanence is what must be stressed and the fact that through it man has succeeded, as he has in other ways by his inventions, in shifting the course of his evolution outside himself.

Only one or two of the literary arts can here be dealt with and, first of all, in prose literature the novel may be referred to, since in many ways it is akin to the drama. It is of recent growth, in fact it was only in the eighteenth century that it first became prominent in literature, though the telling of stories in one form or another is a much more ancient accomplishment. In the mythology of all peoples there are numerous tales, and the frequency with which they deal with animals (fables) is of considerable ecological interest, when we reflect on the kind of relationships, we have seen, have always existed between primitive man and the animal world.

In the modern novel there are few of man's ecological responses that have not been in one way or another explored. As an artist the novelist enjoys a freedom which other artists do not, to the same extent, possess. On the other hand, his art is not so clearly defined. Novels are almost infinitely varied in their aims and in their appeal. Some appeal mainly to the emotions, some are almost coldly intellectual and descriptive, but they all, in so far as they are true works of art, are efforts of the imagination. Like the drama they create worlds of their own. They have been classified in various ways, e.g. the psychological novel, the novel of character, the novel of action, the dramatic novel, the period novel, the historical novel, the adventure novel, the erotic novel, the sociological novel, the novel with a purpose, and so on. The subject-matter is almost co-extensive with man's accumulated knowledge. The ecologist is mainly interested in the use the novelists make of their material and in the life that they create. In some novels he finds that environment is very carefully dealt with, and the task of the novelist is full of interest because the environment, like the other members of the biological triad, is not necessarily a faithful photographic picture of the world of reality but is one that the novelist

himself creates. In the same way the characters are formed by him and the functional responses that are shown to occur should be those that naturally follow, should be such as to produce a completely satisfying whole. In other words the ecologist finds himself analysing the fictional life in the same way as he would analyse real life. He finds himself classifying novels ecologically according to how the fundamental triad is viewed in them, whether from the environmental end or the organism end or mainly functionally. Some novels are almost purely morphological, but the ecologist (who may be biased) would like to regard the greatest novel as the one which obtains the truest balance between environment, function, and organism.

Poetry is the one of the arts which is most difficult to define accurately since the word is often applied to any expression of imaginative feeling, but the definition given by Watts-Dunton (1929) of *absolute poetry* as 'the concrete and artistic expression of the human mind in emotional and rhythmical language' is in the main satisfactory. The poet works with words as his material; and poetry, depending partly, for its aesthetic effects, on sound and rhythm, has much in common with music. But words have meaning and not only meanings but innumerable associations and their effect is such that the emotions and feelings aroused by them are, on the one hand, far more specific than, and on the other hand as suggestive as the sounds we listen to in music. Poetry, therefore, is commonly regarded as the greatest of the arts, though it must always remain somewhat of a hybrid art. There are poets whose appeal is mainly through the emotions aroused by the music of their verse; their poetry *is* music and has the same 'meaning' for us as music has, and any other meaning it possesses is of secondary importance.

Poetry, however, can go much farther than music in revealing to our understanding in a clear, vivid, and intense manner the realities of life. The philosopher Bergson confesses that the intuition of the poet is a surer guide than the analysis of the metaphysician and the same thought has been expressed by many other great thinkers. B. Croce (1929) says that if we examine a poem in order to determine what it is that makes us feel it to be a poem, we at once find two



constant and necessary elements: a complex of *images* and a *feeling* that animates them. Yet poetry must be called neither feeling nor image nor even the sum of the two, but 'contemplation of feeling' or 'lyrical intuition' or (which is the same thing) 'pure intuition'—'pure, that is, of all historical and critical reference to the reality or unreality of the images of which it is woven, and apprehending the pure throb of life in its ideality'. Not only poetry but, for Croce, all art is intuition and, in essence, this is a position with which the ecological view-point need not disagree. Art does not, after all, differ, except in degree, from the whole experience of life in its ecological essentials which, from infancy onward, each of us undergoes. From the commencement, as we slowly learn to interpret experience and respond to the blurred environment that surrounds us, we continually make use of the same intuitional process which in the poet and the artist reaches a climax. We are all poets to some degree. It follows that the highest poetry or the highest art is but another name for the highest experience of life.

The philosophy of art has in modern times tended to give place to a science of art based on an empirical method of approach. The physical characters of beautiful objects have been studied and compared and the psychological reactions of people to such objects have been investigated. There has also been an approach from the evolutionary standpoint. Primitive art and the art of children have been investigated. Read (1933), who summarizes the aesthetics of modern art, gives it as his opinion that we can learn more of the essential nature of art from its earliest manifestations in primitive man (and in children) than from its intellectual elaboration in the great periods of culture. Space does not permit of our following out all the numerous experiments in modern art of all kinds—not only in painting but in poetry, music, drama, and the novel as well. It is an age of experimentation. Read (*loc. cit.*) says that the modern artist is seeking for something underneath appearances and is of the opinion that there is no kind of contemporary art which is not justified by a phrase of Cézanne's: 'I have not tried to reproduce Nature: I have represented it.'

As we look back over the whole field of ecology we see

that not only is it concerned with a study, made as well-balanced as possible, of the threefold nature of life (environment—function—organism), but it also has three different aspects of its own. First of all ecology is a science, with its own special technique, by which, like every other science, it analyses and investigates the phenomena of Nature. In the second place ecology has a very comprehensive view-point of its own, so that it may be regarded as a philosophy. After all every single philosophy, in essence, is merely this—a view-point, a special way of looking at things, a special way of regarding the ultimate reality of life and nature—and this applies equally to the subject of ecology. In the third place ecology is to be looked upon as an art. It has much in common with the art of architecture. It provides a plan, a pattern into which can be fitted everything that we know of man, his responses, his activities, and his works. In brief, as it has been our aim to show throughout, ecology endeavours to understand how and why man is as he is and how and why he behaves as he does.

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